



Competitiveness and welfare of smallholder vegetable farmers in Nkangala District, Mpumalanga Province, South Africa

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Dissertation accepted in fulfilment of the requirements for the degree Masters in Agricultural Economics at the North-West University

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Graduation: July 2024

DECLARATION

I, Vincent Sizwe Mahlangu (27652440), declare that the dissertation entitled “Competitiveness and welfare of smallholder vegetable farmers in Nkangala district, Mpumalanga Province, South Africa” submitted to the Department of Agricultural Economics and Extension was solely prepared by myself and has not been submitted by anyone previously at any institution. I declare that all materials and the work of others have been duly acknowledged utilizing complete references. The NWU Research Ethics Committee has awarded me an ethical clearance certificate, with the following reference number: NWU-00464-21-A9

Signature of the student: VS Mahlangu Date: 2024/05/22.

Supervisor(s) signature: KKS Nxumalo Date: 2024/05/22

ABSTRACT

Smallholder vegetable gardening is critical for income, food security, and rural development in South Africa. However, competitiveness limits limit market access and business viability. Using Porter's Diamond Model, this study analysed the competitiveness and well-being of smallholder vegetable growers in Nkangala District, Mpumalanga Province. A mixed methods technique was used to poll 93 farmers across two towns. The data was analysed using descriptive statistics, reliability testing, principal component analysis, and stochastic profit frontier modelling. The data revealed that the typical farmer was 44 years old, with an equal gender distribution. The majority of farmers had a secondary or tertiary education, and 66.7% worked primarily in agriculture. According to principal component analysis, market factors had the biggest impact on competitiveness, accounting for 32% of the variance, followed by production factors at 19%. The stochastic profit frontier model assessed mean profit efficiency at 68%, implying a potential 32% increase in competitiveness. Age, education, group membership, off-farm income, market access, and extension services were all significant predictors of profit efficiency. Therefore, an integrated approach is necessary to increase the competitiveness of smallholder vegetable farmers, with an emphasis on productivity, risk reduction, market linkages, value addition, social capital, and institutional assistance. The study discovered that increasing competitiveness can improve the economic well-being and overall human development of smallholder vegetable growers by providing greater, sustained incomes. The primary policy recommendations are to improve market access, provide targeted extension services, and promote farmer organisation and collective action. These insights can help to shape evidence-based policies and programmes for the sector.

Keywords: Vegetable, smallholder, competitiveness, welfare

ACKNOWLEDGEMENTS

First and foremost, I would like to thank the Almighty God for opening up the way for me, you had it all planned. Thank you, Lord, for the wisdom, knowledge, guidance and the power to sail through, you made the accomplishment of this task possible for me. Further, I would like to express my sincere gratitude to my supervisor, Dr. KKS Nxumalo and my co-supervisor Ms. T.C Maselwa, whose door was always opened to me for guidance, constructive criticism, encouragement, enthusiasm and friendship.

Moreover, I would like to give thanks to the Department of Agriculture, Rural Development, Land and Environmental Affairs in Nkangala district for assisting with data collection. I send my sincere gratitude to the National Research Foundation (NRF) for financial assistance during the duration of my studies.

Sincere gratitude and thanks also go to my family members, who always gave me hope and constant encouragement when I was about to give up. Thank you very much for your love and support. Throughout every milestone along the road, your encouragement kept me going until the end. To my mother, there are not enough words in the word which can describe my gratitude for everything you are and all you continue to do for me. I have seen how your heart breaks when I am sad or heartbroken, but I am looking forward to seeing your tears of joy at my graduation.

Lastly, to everyone and others whose names I have omitted yet they were instrumental in my studies, thank you and may the good Lord continue blessing you and meeting you, especially at the point of need.

DEDICATION

This dissertation is dedicated to the memory of my Late Father, Mr. DP Mahlangu, and my lovely mother, Ms. DG Masango. I am what I am today because of you.

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ACRONYMS

AgriSETA	Agricultural Sector Education and Training Authority
CAADP	Comprehensive Africa Agriculture Development Programme
DAFF	Department of Agriculture, Forestry and Fisheries
EFA	Exploratory Factor Analysis
FAO	Food and Agriculture Organisation
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GM	Gross Margin
IDC	Industrial Development Corporation
IDP	Integrated Development Plan
IMD	Institute for Management Development
KMO	Kaiser-Meyer-Olkin
NAMC	National Agricultural Marketing Council
NDP	National Development Plan
OECD	Organisation for Economic Co-operation and Development
PCA	Principal Component Analysis
PLAAS	Institute for Poverty, Land and Agrarian Studies
RCA	Relative Comparative Advantage
SEDA	Small Enterprise Development Agency
SPSS	Statistical Package for the Social Sciences
SPF	Stochastic Profit Frontier
StatsSA	Statistics South Africa
STATA	Statistical Analysis Software
SWOT	Strengths, Weaknesses, Opportunities, Threats
UNCTAD	United Nations Conference on Trade and Development
VIF	Variance Inflation Factors
WEF	World Economic Forum
WHO	World Health Organisation

CHAPTER 1: INTRODUCTION OF THE STUDY

1.1 Introduction

This chapter begins with the background of the study, followed by the identified problem statement. Later, research questions, the purpose of the study, research objectives, hypotheses, significance of the study, delimitation, definition of terms, and chapter outline are presented. The main aim of this study was to assess the competitiveness and welfare status of smallholder vegetable farmers in Nkangala District Municipality, Mpumalanga province of South Africa. The chapter is concluded by way of a summary.

1.2 Background of the Study

South African horticultural industry produces a wide range of horticultural commodities such as fruits and vegetables; these products are produced in different areas throughout the country. The industry has been recently progressive in terms of the endowment to overall agricultural production (AgriSETA, 2018; Department of Agriculture Forestry and Fishers (DAFF), 2018). According to AgriSETA (2018), this industry has contributed about 28.8% of the annual gross value of agricultural production and over a third of overall employment. Most production is rain-fed, but irrigated products are cultivated more particularly for market reasons to meet the demand. Fruits are the major exports of the industry, while vegetable production is largely for the local market with a relatively small share of 2% of exports to Southern African Development Communities (SADC) and other countries in Asia such as Singapore, Hong Kong, Malaysia, and Indonesia (DAFF, 2018; Farmer's Weekly, 2018).

Vegetables are leafy green, stem or rooted high-value crops of an edible plant. Vegetables play a crucial role in the prevention of micronutrient deficiencies and the prevention of diseases. According to Bvenura and Sivaku Mar (2017), vegetables are an important source of balance and health, ultimately contributing to food and nutritional security. Insufficient consumption or intake of vegetables may result in various diseases in humans, such as gastrointestinal cancer deaths, ischemic heart disease deaths, and stroke deaths (World Health Organisation (WHO), 2020; Adeoye, 2020). Such is supported by other authors, who noted that vegetables possess medical properties and are highly nutritious for human health (Chege *et al.*, 2014; Mampholo *et al.*, 2016). Despite the overwhelming evidence of adequate intake of vegetables, vegetable production is

growing in developed and developing countries, including South Africa (Hailu, 2016); this growth is partly due to an increase in health awareness populace based on health benefits associated with the consumption of vegetables (Aku *et al.*, 2018; Dolan & Humphrey, 2000), and may be due to the strong growth of population and consumption of vegetable in Middle East countries of Asia (Farmer's Weekly, 2018). Consequently, demand for vegetables increases and market opportunities as well, which creates enormous opportunities for smallholder farmers to sustain vegetable production.

Worldwide, vegetable production has increased more rapidly, with a primary focus on improving farmers' livelihoods (Fadairo *et al.*, 2019). Production of vegetables in the study area was dominated by small-scale farming, mainly on a small piece of land, with the aim of home consumption and sales. Farmers partake in vegetable production because they are associated with higher returns income and high labour turnover per hectare in smallholder farms as compared to cereal crops (Williams *et al.*, 2017). Such implies that improving rural population roles through creating employment opportunities is directly linked to improving income. Also, several studies that have been done including those of Ferris *et al.* (2014; Zhou *et al.* (2013 and Kirsten *et al.* (2012), have strongly confirmed the significance of smallholder farming in terms of employment and income towards rural population and emphasised how smallholder farmers can improve their competitiveness through active participation in agribusiness value chains and in high-value markets.

Sustaining and enhancing competitiveness in the fresh market remains a challenge among smallholder vegetable producers. Due to high transition costs and technical constraints encountered and considering the nature of vegetables (highly perishable), the quality of products tends not to meet the market requirements (Masikwa, 2018). Consequently, smallholder farmers opt to sell their products at a lower price through informal markets. These farmers end up lacking the motive to continue competing because of low returns while they face high costs. The exclusion of smallholder farmers from partaking in the international market, agribusiness value chain, and high-value markets, hinders most of them from receiving better benefits (Odero *et al.*, 2013). Hence, this is an indication that competitiveness is important for smallholder farmer's advancement in the industry.

According to Ngenoh *et al.* (2019), competitiveness is the capability of the firm to produce goods that accomplish market requirements or criteria while conserving profit and income for a period that allows the firm to survive. Competitiveness depends on the ability of a firm to create greater value for its customers and better benefits for all participants in the chain (DAFF, 2016). The key reason for smallholder farmers is to maintain a competitive position to achieve efficient production and optimise performance concerning different inputs.

Social welfare encompasses the holistic well-being of all members of society, including their physical, mental, economic, and spiritual welfare (Smith, 2020). For smallholder farmers, achieving sustainable and profitable livelihoods is crucial for their overall welfare outcomes. As noted by Khan (2022), social welfare for rural agricultural households is closely tied to their economic welfare derived from farming activities. Sustained farm incomes enable investments in healthcare, education, nutrition, and overall quality of life. Furthermore, profitability reduces vulnerability to shocks. Thus, policies and strategies that enhance the competitiveness and viability of smallholder production systems also positively impact the multidimensional welfare of farming communities. Agriculture is vital to the welfare of rural smallholder farmers in emerging nations like South Africa. Khan (2022), states that agricultural households' social welfare depends on their economic welfare from farming. Profits and farm revenues fund healthcare, education, nutrition, housing, and other human development needs. According to Robeyns (2017), economic welfare increases people's substantive freedoms and possibilities, allowing them to live meaningful lives in society.

Agricultural profitability avoids distress migration and destitution by increasing income and reducing vulnerability to exogenous shocks. Dorward *et al.* (2009), show that competitive and viable farming systems give rural households resilience and food security through unexpected weather, price, or policy changes. Thus, agricultural growth affects rural poverty and human welfare (Lipton, 2005). In this context, tactics and policies to boost smallholder farming system competitiveness can help marginalised agricultural communities socially. Targeting productivity, market accessibility, and institutional assistance can sustainably improve low-income farmers' economic and multidimensional well-being. Considering the complex links between human welfare and competitiveness,

this study evaluated smallholder vegetable producers. Data on competitiveness and restrictions is essential for social welfare policymaking.

1.3 Problem Statement

The agricultural industry in South Africa has experienced substantial social, political, and economic transformations, resulting in its integration into global markets (DAFF, 2011; Sandrey et al., 2008). Nevertheless, small-scale farmers residing in rural regions persistently encounter obstacles when it comes to accessing agricultural markets. This hampers their ability to enhance farm output and improve their living conditions (Chamberlin & Jayne, 2011; Mdlalose, 2016). Small-scale vegetable growers, specifically, frequently live in isolated rural regions with insufficient transportation, underdeveloped market infrastructure, and ineffective institutions, resulting in elevated transaction expenses (Pathak et al., 2019). Furthermore, the limited availability of market information and insufficient connections with trading partners serve as additional obstacles for small-scale vegetable growers in accessing profitable markets (Fan & Salas Garcia, 2018).

Recent research indicates that a significant number of small-scale farmers are not benefiting from the potential for expansion offered by high value selling networks (Chelang'a et al., 2013). These farmers encounter several obstacles to their competitiveness and experience market failures within the value chains. These challenges include low productivity, subpar product quality, insufficient adherence to standards, and a lack of social networks (Narrod et al., 2015). Additionally, they face challenges in obtaining sufficient funding, which hinders their ability to make lucrative investments in agricultural inputs (Dorward, 2009; Simelani, 2021). Moreover, smallholder vegetable farmers are highly susceptible to external shocks, such as prolonged droughts, which can destroy their investments and lead to substantial financial losses. This is because their production heavily depends on the timely utilisation of hybrid seeds, fertilisers, and a consistent water supply.

Prior studies examining the competitiveness and profitability of South African horticultural produce have mainly concentrated on macro-level analyses, such as projected pricing systems and trade agreements. These studies have given little attention to the management-related adaptations made by farmers and the technical and economic

efficiency at the household level (Esterhuizen & Van Rooyen, 2019; Madima, 2010; Dlikilili, 2018). The actual and potential impact of efficiency on the competitiveness of smallholder vegetable farmers has not been sufficiently investigated.

This study seeks to fill this need by evaluating the competitiveness and economic well-being of small-scale vegetable growers in the Nkangala District of Mpumalanga Province, South Africa. The study will utilise the Porter's Diamond Model framework to thoroughly analyse the aspects that impact the competitiveness of these farmers, with a specific emphasis on their economic efficiency as a crucial driver of their overall performance and capacity to engage in profitable marketplaces. The project aims to analyse the difficulties and advantages that small-scale vegetable producers encounter. It will offer evidence-based knowledge to inform the creation of specific interventions and policies that can improve their competitiveness, economic well-being, and overall human development.

1.4 Main Research Question

What is the competitiveness and welfare of smallholder vegetable farmers in the Nkangala District?

1.4.1 Sub-research questions

Specific research questions are:

- I. What are the socio-economic characteristics of smallholder vegetable farmers in the study area?
- II. What are the factors affecting the competitiveness of smallholder vegetable farmers, and how is the relationship between these competitiveness factors and commercialisation process in the study area?
- III. What is the level of farm competitiveness among smallholder vegetable farmers in the study area?
- IV. What is the welfare status of smallholder vegetable farmers in the study area?

1.5 Main Research Objective

The main objective of this study is to assess the competitiveness and welfare of smallholder vegetable farmers in the Nkangala District Municipality.

1.5.1 Sub-research objectives

This study was based on the following specific objectives:

- I. To identify and profile the socio-economic characteristics of smallholder vegetable farmers in the study area.
- II. To examine factors affecting the competitiveness of smallholder vegetable farmers, and the analysis of the relationship between these competitiveness factors and the commercialisation process in the study area.
- III. To estimate the level of farm competitiveness among smallholder vegetable farmers in the study area.
- IV. To evaluate welfare status of smallholder vegetable farmers in the study area.

1.6 Hypotheses of the Study

The study was based on the following two hypotheses:

H0: There is no statistically significant relationship between market, production, and institutional factors and the level of competitiveness of smallholder vegetable farmers.

H1: There is a statistically significant relationship between market, production, and institutional factors and the level of competitiveness of smallholder vegetable farmers.

H0: There is no statistically significant relationship between socio-economic characteristics, costs of inputs, and economic efficiency of smallholder vegetable farmers.

H1: There is a statistically significant relationship between socio-economic characteristics, costs of inputs, and economic efficiency of smallholder vegetable farmers.

1.7 Significance of the Study

South Africa's agricultural sector is of a dual economy, divided by commercial farmers, and most small-scale farmers are in relatively inaccessible areas (Scotcher, 2010). Moreover, this sector remains a base for improvements in rural areas. According to the United Nations 2019, it is estimated that by 2050, the world's population will increase by over 9 billion. To supply such a population, it will require better performance, especially from smallholder farmers since they dominate the sector. Vegetable production blooming

in the study area; however, no studies had been conducted regarding vegetable farming. Thus, this study was conducted to fill the knowledge gap and give more clarity on vegetable farming performance. Lastly, the study would provide a base for further research on the competitiveness of vegetables among small-scale farmers and encourage other researchers to conduct similar studies, especially in rural areas of South Africa.

Likewise, the key motivation of the study is to benefit various players in the production system. Estimation of production efficiency and highlighting production and marketing constraints facing smallholder producers would assist policymakers and implementers in pointing out potential areas of improvement. So, it would go a long way in enhancing vegetable production for both small and large-scale farmers. Such, in turn, contribute to a broader knowledge and understanding of the subject studied and advanced strategies in the repositioning of production systems to benefit the development of smallholder farmers and traders in Nkangala district and South Africa in general. Additionally, this study investigated the challenges facing farmers in Nkangala district. Thus, the findings from this study serve as a benchmark to assist policymakers and related stakeholders in redirecting policies associated with significant vegetable production and marketing for the economic gain of farmers not only in the study area but also in South Africa as a whole.

1.8 Limitations and Delimitations of the Study

This study was conducted in the Nkangala district in the Mpumalanga province of South Africa and delineated a sample of smallholder vegetable farmers in the district. Such is responsible for assessing the competitiveness of smallholder vegetable farmers in the Nkangala district of Mpumalanga. The study did not consider smallholder livestock farmers because of the increased demand for vegetables for both local and international markets as people are shifting their diet to healthy food.

Smallholder farmers are scattered within the district, so this study was limited to the specific municipalities, which are Dr. JS Moroka and Thembisile Hani Local Municipality. These municipalities were chosen because they have more smallholder farmers than others. Such means that the outcomes of this study cannot be generalised for all smallholder vegetable farmers in other parts of South Africa because even though smallholder farmers share some similar characteristics, they have some slight

differences, too. Lastly, this study focused only on three vegetables, namely spinach, cabbage, and carrots. These commodities were chosen because they are the most planted in the district.

1.9 The Study Outline

This study was carried out to analyse the competitiveness of smallholder vegetable farmers in Nkangala district, Mpumalanga province, RSA. This was done by dividing the research into five chapters. Chapter One is the introduction to the study. Under the introduction, there is the background of the study, problem statement, justification of the study, research questions and objectives, hypotheses, and organisation of the study. Chapter Two is based on a literature review and conceptual framework, while the research methodology, population of the study, sample size, sampling technique, data collection tool, and methods of data analysis are presented in Chapter Three. Chapter Four consists of the results and discussion of the study. Lastly, the summary, conclusion, major findings, and recommendations aligned with the major findings of the study are presented in Chapter Five.

1.10 Chapter Summary

The chapter presented the background of the study, the problem statement, objectives, questions, and hypotheses. It further expatiated the significance of the study, which indicates the importance of competitiveness of smallholder vegetable farmers. Lastly, the study outline and summary of the chapter were also presented. The literature review is presented and discussed in the following chapter (Chapter Two) of the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter defines the theoretical construct for the study. It first provides a summary of the concepts and evolution theories of competitiveness. Such is carried out by reviewing the relevant literature that the stated research objectives and hypotheses of the study. The literature review chapter begins by defining smallholder farmers in South Africa and discussing their contribution to the agricultural sector. It then covers the concept of competitiveness, providing definitions at both macro and micro levels. Such is followed by a review of various indicators and techniques used to assess competitiveness, including measures applicable at macro and micro levels. The chapter then explains the conceptual model of the study grounded in efficiency as an indicator of competitiveness. The Porter's Diamond Model is discussed as a framework for analysing competitiveness factors. The relevance of this model for farm-level analysis is highlighted. Determinants of competitiveness found in the literature are then outlined, including farm structural factors and farmer socio-economic characteristics. Finally, the chapter summarises the key literature on smallholder competitiveness and welfare, providing a foundation for the study's methodology and analysis.

2.2 Theoretical Framework.

Understanding the value of a strong theoretical framework in a research project is critical. It provides a structured foundation for developing research questions, determining appropriate procedures, and effectively interpreting findings (Adom et al., 2021). This lens provides a firm foundation for the study by ensuring that the research topic and objectives are assessed in light of well-established theories and concepts (Kivunja, 2020). Understanding the theoretical framework is critical for locating the study within academic discourse and lending legitimacy and rigour to the research. It demonstrates the researcher's understanding of the underlying theoretical assumptions (Palinkas and Soydan, 2022). The theoretical basis for this study on the competitiveness and economic efficiency of smallholder vegetable producers will be based on two complementing theories: Porter's Diamond Model and Resource-Based View (RBV). These theories provide a comprehensive framework for understanding the different aspects influencing the competitiveness and efficiency of smallholder agricultural companies.

2.2.1 Porters Diamond Model

The Porter's Diamond Model is based on substantial study undertaken by Michael Porter, a widely regarded economist and management scientist. Porter's seminal 1990 paper "The Competitive Advantage of Nations" set the foundations for the model's theoretical foundation. Porter's research looked at the long-standing subject of why certain countries excel in specific industries, challenging conventional notions of comparative advantage (Porter, 1990). The Porter's Diamond Model, which resulted from this research, has received widespread acceptance as a framework for analysing the competitiveness of sectors and nations (Ketels, 2020). According to Porter's Diamond Model, the competitiveness of an industry or a nation is influenced by four interlinked factors: factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and competition (Porter, 1990). The determinants, the role of the government, and chance events all contribute to the formation of a dynamic system that determines the competitive landscape of a particular industry or nation (Huggins et al., 2021).

Factor circumstances are critical for production and include the availability and quality of vital inputs such as natural resources, infrastructure, skilled labour, and technological capabilities (Porter, 1990). The demand conditions include different features of the local and worldwide markets, such as consumer sophistication, market size and growth rate, and the presence of specialty segments (Ketels, 2020). The availability and quality of upstream and downstream sectors, as well as their supplementary products or services, have a significant impact on the main industry's success. Synergies and collaboration with related and supporting industries can significantly help the focus industry (Huggins et al., 2021). The firm strategy, structure, and rivalry element investigates the industry's competitive dynamics, such as organisational structures, managerial practices, and competition intensity (Porter, 1990).

The Porter's Diamond Model has been widely used in the field of agricultural competitiveness because it provides a comprehensive framework for understanding the various aspects that influence the performance and achievements of agricultural firms (Benos et al., 2021). When investigating smallholder vegetable producers, one useful way is to use Porter's Diamond Model. This model provides for an investigation of the various elements that influence these farmers' competitiveness and economic efficiency, such as

resource availability, market circumstances, institutional assistance, and the competitive landscape (Jari et al., 2021). Using this theoretical viewpoint, the current study can obtain useful insights into the specific aspects influencing the competitiveness of smallholder vegetable growers in the Nkangala District. This data can then be utilised to create tailored interventions and policies to improve their performance and incorporation into profitable value chains.

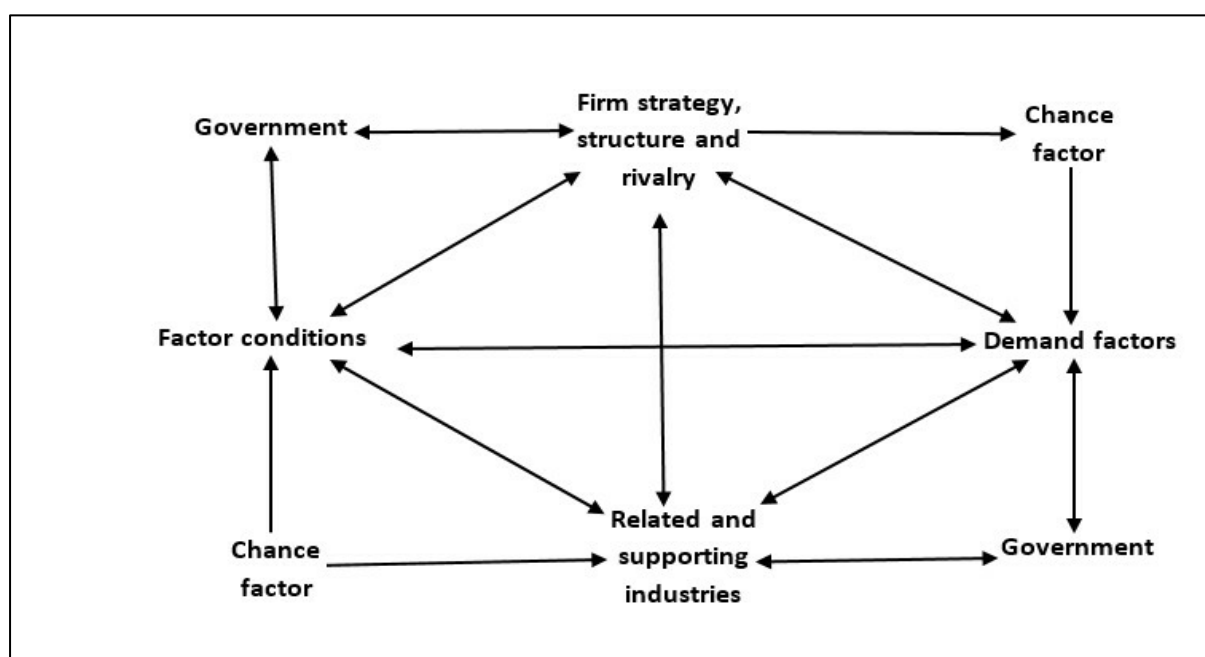


Figure 2.1 Porter diamond model diagram.

Source: Porter (1998) as cited by Dlikilili (2018).

2.2.1.1 2.1.1.1 Accessibility and conditions of production factors

According to Porter (1990), each nation or firm has its production factors, which are labour, land, natural resources, capital, and infrastructure. Porter further grouped these factors of production into physical resources, human resources, capital resources, knowledge resources and infrastructure. These factor conditions subgroups are either necessary or advanced, general, specialised and inherited or created. The advanced, specialised and created factors are highly recommended to achieve sophisticated forms of competitive advantage (Sibulali, 2018). Moreover, Dlikilili (2018) and Kalmias (2020) mentioned that the performance of a firm or farm is what matters the most, as the availability of these factors is not necessarily an indicator of competitiveness.

2.2.1.2 Demand conditions

This segment focuses on local demand for the firm's products or services. The structure of demand distinguishes local demand, sophisticated and changing demand and is protective of the buyer's needs (Bakan & Dogan, 2012). This determinant describes the nature of consumers in the home market. The demand condition is driven by the buyers' requirements that exert pressure on product quality, price, and services in an industry. However, Porter (1990) argues that the demand conditions have an impetus impact on the formation of factor conditions.

2.2.1.3 Firm strategy, structure, and rivalry

This subgroup refers to the "condition in the nation that governs the creation, organisation and management of companies as well as the nature of domestic rivalry" (Abei 2017). Porter (1990) emphasises the fact that the strategies and structures of firms are highly affected by the national environment, and those different countries' business sectors operate uniquely to attain a competitive advantage. Porter (1990) identifies rivalry as the most critical driver of the competitive advantage of a country's firms. Moreover, Porter (1990) believes that domestic rivalry forces firms to be cost-competitive, to improve quality and to be innovative.

2.2.1.4 Related and support industries

According to Porter (1998), the external economies of related and support industry clusters, such as networks of specialised input providers and institutions and the spill-over effects of local rivalry create a competitive advantage. Moreover, domestic rivalry is instrumental to international competitiveness since it forces companies to develop unique and sustainable strengths and capabilities. The more intense the domestic rivalry is, the more firms and firms are being pushed to innovate and improve to maintain their competitive advantage.

2.2.1.5 The role of government support

Government plays an important role in supporting farmers, as it influences demand conditions, factor conditions, rivalry, strategy and structure, and related and supporting industries in either a negative or positive way. For example, subsidies, taxes, financial incentives, education policies, public procurement, quality standards and capital market regulations (Bakan & Dogan, 2012). However, Porter (1990), strongly argues and believes that the government's role is like a catalyst to exert pressure on firms to perform at their best in order to be competitive locally and internationally.

2.2.1.6 Chance factor determinant

Such applies to events that have little or nothing to do with a nation's predominant conditions and are frequently beyond the ability of companies to influence and even the national government. Examples of such occurrences are new inventions, disasters such as droughts, floods, wars, pest plagues and politics.

2.2.1.7 Relevance of Porters diamond level

The competitiveness of industries or countries and firms has been studied or measured among different countries, and the firm is using different approaches and methods. However, these methods differ due to the area of focus of the study (Masikhwa, 2018). For instance, some methods are more suitable for the analysis of competitiveness at the macro level than at the micro level, as highlighted in Tables 2.1 and 2.2 above. From the contrasting studies that have been documented, Porter's Diamond model is one of the most relevant frameworks to determine competitiveness at the micro or farm level rather than at macroeconomic analysis. Porters' Diamond level measures past trends to determine competitiveness and focuses more on macroeconomics other than the microeconomic analysis.

2.2.2 The Resource-Based View (RBV) Theory.

The Resource-Based View (RBV) theory is based on research undertaken by Edith Penrose, an eminent economist who emphasised the importance of a company's internal resources and competencies in defining its competitive advantage (Penrose, 1959). Renowned researchers such as Wernerfelt (1984), Barney (1991), and Peteraf (1993) contributed significantly to the creation and improvement of the RBV theory, firmly establishing it as a dominant theoretical framework in strategic management.

According to the RBV theory, a company's competitive advantage originates from unique and valued resources and talents that rivals find difficult to reproduce or replace (Barney, 1991). These resources can take several forms, including physical assets and intangible factors like information, skills, and organisational procedures (Wernerfelt, 1984). According to the RBV hypothesis, organisations with rare, valuable, inimitable, and non-substitutable resources (VRIN) have a better chance of achieving long-term competitive advantage and superior performance (Barney, 1991).

The RBV theory can help smallholder vegetable producers understand how their internal resources and capabilities affect their competitiveness and economic efficiency. These resources can include a variety of factors, including farmers' expertise, access to land, water, and other essential resources, use of advanced technologies and effective management techniques, and the strength of their social and institutional connections (Mmbengwa et al., 2021). Smallholder vegetable growers can strengthen their competitiveness, economic efficiency, profitability, and wellbeing by strategically aligning their resources with market demands and using their unique talents (Aliber & Hall, 2021).

The RBV theory provides a good perspective for investigating the internal elements that contribute to the competitiveness of smallholder vegetable growers, as well as the external environmental factors, as underlined by Benos et al. (2021). By merging these two theoretical frameworks, the current study seeks to get a full understanding of the numerous factors that influence competitiveness and economic efficiency among smallholder vegetable producers in the Nkangala District. This information will be useful in developing effective policies and initiatives to help this critical industry.

2.2.3 Methodological literature pertaining to the specific objectives.

The methodological literature pertaining to the specific aims of this study offers significant insights into the suitable research methodologies and analytical tools to properly answer the research questions. An important aspect to address in this study is how to evaluate the competitiveness and economic efficiency of small-scale vegetable farmers. Various researchers have utilised quantitative techniques to assess the competitiveness of small-scale agricultural businesses. Kubheka et al. (2020) employed the Policy Analysis Matrix (PAM) methodology to evaluate the competitiveness and comparative advantage of smallholder maize producers in South Africa. The PAM technique enables the computation of many indices of competitiveness, such as the home Resource Cost (DRC) ratio and the Private Cost Ratio (PCR), which offer valuable insights into the farmers' capacity to compete in both home and foreign markets. In a similar vein, Ncube et al. (2021) employed the PAM framework to examine the competitiveness of smallholder vegetable producers in Zimbabwe. Their analysis underscored the significance of policy interventions and market access in influencing the farmers' competitive performance.

Alongside the PAM framework, the use of Data Envelopment Analysis (DEA) has been extensive in assessing the technical, allocative, and economic efficiency of smallholder farmers (Beshir, 2022; Tesfaw et al., 2023). The Data Envelopment Analysis (DEA) method is a non-parametric technique that enables the estimate of relative efficiency scores by optimising the use of inputs and outputs. Through the utilisation of DEA (Data Envelopment Analysis), academics can pinpoint the origins of inefficiency and offer suggestions for enhancing the economic productivity of small-scale farmers.

The literature also uses the Cobb-Douglas production function as a methodological tool to examine the correlation between different inputs and the output of smallholder farming operations (Cheteni et al., 2021; Msangya & Yiheyis, 2022). This parametric methodology enables the calculation of the elasticity of production in relation to various inputs, offering valuable insights into the factors that impact the productivity and efficiency of small-scale farmers.

The choice of suitable sample procedures and methodologies for data gathering is vital while conducting research on smallholder farmers. Researchers have utilised a blend of probability and non-probability sampling techniques to guarantee the inclusiveness of the intended population (Aliber & Hall, 2021; Berhanu & Moti, 2022). Various data collection techniques, including structured interviews, focus group discussions, and the utilisation of secondary data sources, have been extensively employed to acquire comprehensive information on different aspects of smallholder farmer competitiveness and commercialisation (Chikazunga & Paradza, 2021; Delele et al., 2022).

The use of qualitative approaches, such as case studies and in-depth interviews, has been acknowledged as beneficial for gaining contextual insights and a more profound comprehension of the intricate challenges encountered by smallholder farmers (Ouma et al., 2023; Garbero et al., 2020). Combining quantitative and qualitative data through triangulation can improve the trustworthiness and accuracy of research findings, resulting in stronger and more practical recommendations for policymakers and development practitioners.

2.2. Smallholder Farmers in South Africa.

A large amount of literature related to smallholders and small-scale farmers exists, and these terms are often used interchangeably. However, the explanation of these terms is

still a source of debate, meaning that there is no universal definition being agreed upon about the concepts. Smallholder farmers can be described in various ways depending on the context of the study. Smallholder farmers are defined or viewed as farmers or households taking part in any agricultural production with the purpose of home consumption and selling surplus to generate extra to improve their welfare (DAFF, 2012; Scotcher, 2010). According to Pinaar and Traub (2015), these farmers are characterised by small farms that are labour-intensive and use traditional methods to produce their vegetables, low levels of farming skills, and limited access to critical input and output markets. Such characteristics indicate that smallholder farmers generally face significant challenges in accessing value chains (Aliber *et al.*, 2010; Davis, 2013).

2.3 Contribution of Smallholder Farmers to Agriculture

Smallholder vegetable producers' competitiveness is inextricably linked to their ability to effectively participate in and navigate agricultural value chains (Garbero *et al.*, 2020). In this case, competitiveness refers to smallholder farmers' ability to effectively develop, promote, and distribute their products in order to earn an adequate income and improve their overall well-being (Jari *et al.*, 2021). Commercialisation is the process of integrating smallholder farmers into commercial markets, which is an important component in determining their level of competitiveness.

Commercialisation is the process of turning small-scale farming methods that focus on self-sufficiency into businesses that prioritise market sales (Beshir, 2022). Several factors influence this process, including resource accessibility, the presence of requisite infrastructure, market information availability, and institutional assistance (Cheteni *et al.*, 2021). According to research, the level of commercialisation among smallholder farmers has a significant impact on their competitiveness and overall economic performance.

The relationship between competitiveness-enhancing components and the commercialisation process is complex and varied. Smallholder farmers' participation in commercial markets can be directly influenced by competitive qualities such as farm production efficiency, product quality, and market access (Chikazunga & Paradza, 2021). However, the degree of commercialisation can have an impact on the evolution of these competitiveness-enhancing features. Farmers are more motivated to engage in

productivity-enhancing technology and practices when they have greater market access (Msangya & Yiheyis, 2022).

Access to markets has been identified as a critical factor in the commercialisation of smallholder vegetable growers (Kubheka et al., 2020). Small-scale farmers in developing countries usually face significant barriers to accessing profitable markets, such as inadequate transportation infrastructure, limited market information, and reduced bargaining power (Ncube et al., 2021). Market access can be improved by building rural infrastructure, strengthening farmer associations, and upgrading market information systems. These strategies can effectively increase the commercialisation of smallholder vegetable output (Delele et al., 2022).

Production efficiency among smallholder farmers is an important factor that influences competitiveness (Berhanu & Moti, 2022). Farmers with high levels of technical and allocative efficiency can better maximise resource use, resulting in increased productivity and profitability. As a result, they can effortlessly integrate into commercial markets (Tesfaw et al., 2023). Aliber and Hall (2021) identified the availability of extension services, acceptance of new technology, and access to money as critical factors influencing production efficiency among smallholder vegetable producers.

2.4 Competitiveness

Competitiveness as a field of economic study and knowledge has only been researched and taught since the beginning of the 1980s, more especially at the macro level than the micro level. According to Esterhuizen (2019), the concept of competitiveness is built on numerous economic concepts, which can be traced back to classical economists such as Adam Smith and David Ricardo, amongst others. However, competitiveness remains a concept that is not well understood for analytical purposes despite the widespread acceptance of its importance.

2.4.1 Definition of Competitiveness

Several studies were conducted on the competitiveness of industries; however, there is no agreement on its definition or on the exact methods to measure competitiveness

(Latruffe, 2010). According to Porter (1990), the capacity of an industry to innovate and upgrade will ultimately influence the nation's competitiveness.

2.4.1.1 Definition of competitiveness at the macro level

According to Sinngu (2016), competitiveness at the macro level refers to the ability to exchange goods and services on foreign markets while retaining improved revenue levels. In addition, at the macroeconomic level, competitiveness is the country's ability to produce goods and services to meet the demands of the global markets under free trade and fair market conditions while maintaining and increasing the real incomes of farmers over the period (World Economic Forum, 2016).

2.4.1.2 Definition of competitiveness at the micro level

According to Basu (2014), as cited by Nkamisa (2020), competitiveness at the micro-level is defined as “the firm's (or farm in the study's case) ability to produce products and services of high quality and at a lower cost than its local or regional competitors”. In the context of smallholder vegetable farmers in Nkangala district, competitiveness is considered as the ability to grow vegetables efficiently and remain profitable.

2.5 Indicators and Techniques of assessing Competitiveness

2.5.1 Indicators at the macro level

The World Competitiveness Yearbook and the Global Competitiveness Index analyse competitiveness at the macro level. Both the World Economic Forum (WEF) and the International Institute for Management Development (IMD) are Swiss organisations that manage to publish the World Competitiveness Yearbook. The World Competitiveness Yearbook measures each year the competitiveness of countries and companies. This is done through both quantitative and qualitative data. Data were collected through questionnaires for leaders and interviews with participating countries and organisations (Esterhuizen, 2019). The table below illustrates the most prevalent indicators of competitiveness.

Table 2.1 Indicators or measures of competitiveness at a macro level.

Indicator or measure	Description
Relative Trade Advantage	RCA mainly takes into account the country's exports as it does not include imports. So it mainly takes into account the trading intensity.
Revealed Comparative Advantage	The RCA mainly considers the country's exports, as it excludes imports. Hence, it mainly factors trade intensity.
Competitive Indexes	Measuring international competitiveness involves comparing the competitive nature of each country against that of its neighboring countries.

Source: (Abej, 2017; Nkamisa, 2020)

2.5.2 Indicators of competitiveness at the micro level

Researchers have used different indicators and techniques to assess the competitiveness of farm enterprises. However, these measures differ when doing competitive analysis at the firm level. According to Buckley, Pass and Prescott (1998), competitiveness at the firm level is the firm's long-run performance and its ability to provide superior returns to its employers, as well as compensate its employees. From this definition, competitiveness at the firm level should measure the firm's quantitative costs, prices, and profitability, as well as gross margins.

Table 2.2 Indicators or measures of competitiveness at the micro level.

Indicator or measure	Description
Production Function Estimation	It is an econometric estimator of the production function.
Production Cost Comparison	It is used to compare the cost of production and gross margins of different enterprises. The lower the costs, the relative competitiveness.
Gross Margin Analysis	It is used to assess economic efficiency and to compare enterprises with similar traits of production in the value chain.

Source: (Abej, 2017& Dlikilili, 2018).

2.6 Conceptual Model

This study adopted efficiency as a measure appropriate for the assessment of smallholder vegetable farms' competitiveness. Following the definitions applied above, smallholder farmers can stay in business and perhaps advance and maintain market offtake if they are efficient users of farm resources both in the technical and allocative senses (Delgado *et al.*, 2008). This measure was discovered by Farrell (1957) when he established technical, allocative, and economic efficiency.

According to this framework, if a farm's production level is lower than the highest possible output for a certain combination of inputs, it is technically inefficient. A farm is also allocatively inefficient if the inputs are not used in the best combination. A farm can also be scale inefficient in a profit-maximising framework if it is not producing at a level that equalises the product price with the marginal cost (Kumbhakar *et al.*, 1989). It has been argued that inefficiencies linked to changing factor endowments and input and output prices across farms are not well captured by the production function approach (Ali & Flinn, 1989). Thus, this led to the use of a more flexible profit function model to estimate farm-specific efficiency directly. By estimating a stochastic profit frontier (SPF), which allows for measurement error in the econometric estimation of the frontier itself, it is possible to identify the "most efficient" farm (Bahta & Malope, 2014; Kumbhaakar *et al.*, 2001; Wand *et al.*, 1996).

The stochastic profit frontier also allows for the fact that observations for some farms will lie above the estimated “best” frontier points on the stochastic frontier curve (estimated by maximum likelihood methods and labelled MLE) to represent fully efficient farms (on the frontier), and all points below the frontier represent inefficient farms in terms of their specific resources at prevailing input prices. To estimate the stochastic profit frontier, a statistical model is used that relates farm profitability to input variables such as labour, capital, and materials. The model also includes a stochastic error term that captures the effect of random shocks on profitability. Estimating the stochastic profit frontier allows for the identification of relatively efficient firms and those that are relatively inefficient by comparing the actual profitability of a firm to its predicted profitability based on the frontier. An estimation approach of the stochastic profit frontier has two stages. The first stage explains each farm’s unit profit performance in terms of technical and allocative efficiency, and the second explains the differences in efficiency in terms of farm-specific variation. The advantage of this model is that it allows for the estimation of farm-specific efficiency scores and factors explaining efficiency differentials among farmers in a single-stage estimation procedure. **Farm profit** is measured in terms of gross margin (GM), which equals the difference between the total revenue (TR) and total variable cost (TVC) and is given by.

$$GM(\pi) = \sum (TR - TVC) = \sum PQ - WX_i$$

To normalise a profit function, gross margin(π) is divided throughout by P (average market price of vegetables) to get:

$$\frac{(\pi)}{P} = \frac{\sum(PQ - WX_i)}{P} = Q - \frac{WX_i}{P} = \int (X_i, Z) - \sum P_i X_i, \text{ where } \varepsilon_i = V_i - U_i$$

Where $i = 1 \dots, n$ is the number of farms in the sample, π_i is the normalised profit of the i^{th} farm defined as gross revenue less variable cost, divided by farm-specific output price; P_i is the price of vegetable output (Q_i) of the i^{th} farm; Z_i is the vector of a fixed factor of the i^{th} farm. X_i represents the quantity of optimised input used, Z_i represents fixed inputs used, $P_i = \frac{W}{P}$, which represents the normalised price of input X_i while $\int (X_i; Z_i)$ represents the production function. ε_i is an error term that is assumed to behave in a manner consistent with the frontier concept.

2.6 Competitiveness factors and the commercialisation process

The competitiveness of smallholder vegetable producers is closely tied to their ability to effectively participate in and navigate agricultural value chains (Garbero et al., 2020). In this context, competitiveness refers to the smallholder farmers' capacity to effectively produce, promote, and distribute their products, allowing them to generate satisfactory incomes and improve their overall well-being (Jari et al., 2021). Commercialisation is the process of integrating smallholder farmers into commercial markets, which plays a vital role in determining their level of competitiveness.

Commercialisation involves transforming small-scale farming practices that aim to meet basic needs into larger-scale operations that prioritise selling products in the market (Beshir, 2022). The process is influenced by several factors, including the accessibility of resources, the presence of necessary infrastructure, the availability of market information, and the support provided by institutions (Cheteni et al., 2021). According to recent research conducted by Ouma et al. (2023), the level of commercialisation among smallholder farmers is a critical factor in determining their competitiveness and overall economic success.

The relationship between competitiveness variables and the commercialisation process is complex and varied. Various factors play a crucial role in determining the competitiveness of smallholder farmers in commercial marketplaces. These factors include the efficiency of farm production, the quality of products, and the ability to access markets. A study by Chikazunga and Paradza (2021) highlights these factors' direct impact on smallholder farmers' engagement in commercial marketplaces. However, the level of commercialisation can impact the development of these factors that contribute to competitiveness. When farmers have stronger ties to the market, they are inclined to adopt technology and implement practices that enhance productivity (Msangya & Yiheyis, 2022).

Access to markets is a critical factor that significantly impacts smallholder vegetable growers' commercialisation, as Kubheka et al. highlighted in their recent study (2020). Small-scale farmers in developing nations often face significant challenges when accessing lucrative markets. These challenges can include insufficient transportation

infrastructure, limited market information, and a lack of bargaining power (Ncube et al., 2021). The commercialisation of smallholder vegetable output can be enhanced by enhancing market access by advancing rural infrastructure, bolstering farmer organisations, and improving market information systems (Delele et al., 2022).

Production efficiency is a critical factor that impacts competitiveness, as highlighted by Berhanu and Moti (2022). Farmers who demonstrate high technical and allocative efficiency levels can effectively utilise their resources, leading to increased production and profitability. As a result, this allows them to effortlessly blend into commercial marketplaces (Tesfaw et al., 2023). Factors significantly impacting production efficiency among smallholder vegetable farmers include access to extension services, new technology adoption, and credit access, as highlighted by Aliber & Hall (2021).

Various institutional factors heavily impact the commercialisation of smallholder vegetable production. These factors include the presence of favourable policies, the effectiveness of farmer organisations, and the accessibility of financial services (Chikazunga & Paradza, 2021). Implementing policies that promote the inclusion of smallholder farmers in value chains, enhance their access to credit and insurance, and strengthen their collective efforts can significantly enhance the competitiveness and commercialisation of this sector (Nhundu et al., 2022).

In recent years, vegetable product quality and safety have become increasingly vital for maintaining competitiveness in both local and international markets (Mgaga et al., 2020). Small-scale farmers who meet the quality and safety standards required by commercial buyers have a more significant opportunity to join profitable value chains, which can boost their commercial success (Mabhaudhi et al., 2021). The literature highlights the intricate relationship between competitiveness factors and the commercialisation process among smallholder vegetable growers. Market access, production efficiency, institutional support, and product quality and safety are crucial in determining the level of involvement and benefits that small-scale farmers can achieve in commercial agricultural value chains. Developing a thorough understanding of these connections is crucial for creating effective policies and interventions to enhance this crucial industry's competitiveness and well-being.

2.6.1 Factors Affecting Smallholder Farmers' Commercialisation

2.6.1.1 Access to productive resources and agricultural inputs.

The availability and quality of productive resources including as land, water, and agricultural inputs are critical to the commercialisation of smallholder farmers (Mmbengwa et al., 2021). Smallholder farmers frequently face considerable barriers to getting critical inputs such as quality seeds, fertilisers, and equipment, limiting their capacity to boost production and fulfil market demands (Cheteneni et al., 2021). Improving the availability and affordability of these inputs, either through targeted subsidy programmes or the establishment of input supply chains, can help smallholder farmers become more commercial (Beshir, 2022).

2.6.1.2 Access to Financial Services

Another important element impacting smallholder farmers' commercialisation is their access to financial services such as credit, savings, and insurance (Aliber and Hall, 2021). Farmers' ability to invest in productivity-enhancing technologies, boost production, and manage production risks is limited due to a lack of access to financial capital, impeding their integration into commercial value chains. Improving the availability and affordability of financial services, through the establishment of rural financial institutions and the promotion of digital finance solutions, can greatly aid in the commercialisation of smallholder farmers (Benos et al., 2021).

2.6.1.3 Extension Services and Access to Information

Effective extension services, as well as access to knowledge on improved agricultural practices, market prospects, and value chain linkages, are crucial for smallholder farmers' commercialisation (Tesfaw et al., 2023). Smallholder farmers frequently lack access to relevant and timely information, reducing their ability to make informed decisions and meet market needs (Ouma et al., 2023). Strengthening extension services, utilising digital technology, and encouraging farmer-to-farmer knowledge sharing can help to commercialise smallholder agricultural production (Garbero et al., 2020).

2.6.1.4 Collective Action and Farmers' Organisations

Smallholder farmers' participation in collective action through farmer organisations, cooperatives, or producer groups has long been recognised as a critical aspect in aiding commercialisation (Berhanu & Moti, 2022). Farmer organisations can help smallholder farmers overcome scale and bargaining power constraints, allowing them to access input

and output markets, negotiate higher prices, and participate in profitable value chains (Chikazunga & Paradza, 2021). The formation of robust and inclusive farmer organisations is thus critical in boosting the commercialisation of smallholder agriculture (Delele et al., 2022).

2.6.1.5 Government Policy and Institutional Support

The influence of government policies and institutional support for the commercialisation of smallholder farmers cannot be emphasised. Effective policy interventions, such as targeted input subsidies, investment in rural infrastructure, and financial and consulting services, can greatly improve smallholder agricultural companies' commercial orientation (Jari et al., 2021). Furthermore, the availability of supportive institutions, including as well-functioning agricultural markets, efficient input supply chains, and effective extension systems, might foster the commercialisation of smallholder farmers (Ncube et al., 2021).

The degree of commercialisation among smallholder farmers is determined by the interplay of these multidimensional elements, which include access to resources and markets, institutional support, and collective action. Understanding the complex dynamics of these elements is critical for developing and implementing effective policies and interventions to promote the successful integration of smallholder farmers into profitable agricultural value chains.

2.6.2 The Relationship of Competitiveness Factors and Commercialisation Level

The previous literature has investigated the complex relationship between smallholder farmers' competitiveness determinants and their level of commercialisation, emphasising the reciprocal nature of these two variables.

2.6.2.1 Competitiveness Factors and Commercialisation

Several studies have shown that smallholder farmers' competitiveness, as measured by criteria such as resource availability, production efficiency, and market access, is a crucial determinant of their level of commercialisation (Kubheka et al., 2020; Ncube et al., 2021). Smallholder farmers who are more competitive, as measured by their ability to utilise productive resources, adopt new technology, and effectively engage with markets, are more likely to shift from subsistence to market-oriented agriculture (Ouma et al., 2023).

Smallholder farmers' competitiveness can, however, be influenced by their level of commercialisation. As smallholder farmers become increasingly integrated into commercial value chains, they may get better access to information, technologies, and markets, increasing productivity and efficiency and thereby boosting their competitiveness (Garbero et al., 2020). This reciprocal relationship between competitiveness determinants and the commercialisation process emphasises the need of resolving smallholder farmers' multifaceted restrictions in order to facilitate their effective integration into lucrative value chains (Berhanu & Moti, 2022).

2.6.2.2 Moderating factors and pathways.

The research has also discovered some moderating factors that influence the relationship between smallholder farmers' competitiveness and amount of commercialisation. For example, the availability of institutional support, such as credit, extension services, and collective marketing arrangements, can help smallholder farmers leverage their competitiveness and expand their commercial activities (Cheteni et al., 2021; Delele et al., 2022).

Similarly, the improvement of infrastructure, such as rural roads and market facilities, can help smallholder farmers get access to high-value markets, allowing them to leverage their comparative advantages to increase commercialisation (Benos et al., 2021). The strength of farmer organisations and their bargaining power in the value chain have been shown to mediate the relationship between competitiveness and commercialisation, as collective action can assist smallholder farmers in overcoming scale and market access challenges (Chikazunga & Paradza, 2021).

The intricate interplay between competitiveness determinants and smallholder farmers' commercialisation levels emphasises the need for a comprehensive, multifaceted approach to assisting the development of this critical agricultural sector. Addressing the restrictions and increasing the enablers that define smallholder farmers' competitiveness and commercialisation can result in long-term gains in their livelihoods and integration into profitable value chains.

2.7 Smallholder Farmer's Welfare.

2.7.1 Concept of smallholder farmer's welfare

The welfare of smallholder farmers is a complex construct that encompasses various dimensions, including but not limited to economic, social, health, and other facets of well-being that are pertinent to agricultural households (Sumner, 2020). The concept extends beyond mere financial resources to encompass a range of factors such as individual capabilities, preservation of dignity, availability of social support networks, and the long-term sustainability of the natural resources upon which individuals depend (Obayelu, 2020). Scholars widely emphasise that the provision of welfare to smallholding groups encompasses not only material resources such as land, livestock, and housing, which are essential for their sustenance but also intangible resources such as social capital, which play a crucial role in providing psychological support (Sabates-Wheeler, 2019). Welfare economics offers a normative framework for assessing policies and processes that impact the livelihoods of smallholder farmers, drawing upon principles of equity, justice, and propriety (Obayelu, 2020). The emphasis is placed not solely on the practical usefulness of resources but rather on the broader objective of enhancing individuals' capacities and liberties to pursue their well-being actively. The provision of public goods, the accumulation of assets, the establishment of safety nets, and the cultivation of resilience to external shocks are crucial factors contributing to the overall well-being of marginalised small-scale farmers.

2.7.2 Relationship between competitiveness and smallholder welfare

The augmentation of competitiveness serves to elevate the levels of productivity, efficiency, and incomes for smallholder farmers, as posited by Obayelu (2020). The statement above by Masterson (2019) highlights the ability of individuals or entities to effectively embrace appropriate technological advancements, gain entry into lucrative markets, and efficiently allocate resources. The enhancement of competitiveness can, therefore, catalyse the promotion of overall welfare benefits for small-scale farmers and rural communities (Diao *et al.*, 2018). According to Khan (2022), the implementation of agricultural development initiatives has the potential to significantly enhance rural incomes, thereby facilitating the attainment of fundamental necessities, fostering the accumulation of human capital, and ultimately elevating overall living standards. As exemplified by the empirical study conducted by Ward and Santos (2010), the implementation of fertiliser adoption in the context of Malawi has yielded notable enhancements in terms of competitiveness, particularly with regard to maize production.

These improvements have subsequently led to positive outcomes in various welfare indicators, including but not limited to food security, health, and education, specifically among smallholder farmers. Addressing the limitations that impede the competitiveness and sustainability of small-scale agricultural enterprises is of paramount importance, not only for economic prosperity but also for the overall well-being across various dimensions.

2.7.3 Drivers of smallholder farmer's welfare

Several key factors significantly influence the welfare outcomes for smallholder farmers. These factors encompass productivity growth achieved through the process of commercialisation, the accessibility to markets and services, the ability to withstand and recover from various shocks, and the development of human capital. The process of agricultural commercialisation has the potential to generate income and provide farmers with expanded options in various domains such as healthcare, education, nutrition, and women's empowerment (Carletto *et al.*, 2017). However, it is important to note that the benefits discussed in this context are contingent upon various factors, thereby requiring the implementation of policies that facilitate the development of technology, infrastructure, institutions, and social protection mechanisms (Reardon *et al.*, 2019).

The acquisition of market access, inputs, extension support, and financial services plays a crucial role in effectively leveraging commercialisation efforts to enhance the well-being of smallholder farmers (Genicot & Ray, 2017). Market linkages can be facilitated through investments in various areas such as transport, storage, market information systems, and value chain infrastructure. Small-scale agricultural producers are susceptible to the adverse effects of climatic variations, infestations by pests and diseases, as well as instability in food prices (Obayelu, 2020). The imperative nature of resilience can be achieved through the strategic implementation of income diversification, savings, insurance, and safety nets. Human capital development, as elucidated by Lanjouw *et al.* (2018), encompasses the multifaceted dimensions of health, education, and skills initiatives. This comprehensive approach not only serves to augment productivity levels but also exerts a direct positive influence on overall welfare. The implementation of comprehensive programmes encompassing various domains such as nutrition, education, digital literacy, and vocational training has been widely acknowledged as a catalyst for fostering socio-economic prosperity.

2.7.4 Gaps in literature

Despite the considerable amount of research that has been conducted about agriculture-welfare linkages, it is important to acknowledge that there are still existing gaps in our understanding. Limited research exists that offers context-specific evidence regarding the tangible improvements in smallholder welfare resulting from competitiveness strategies (Deb *et al.*, 2020). Further investigation is warranted to explore the heterogeneity in impacts across various groups, as highlighted by Djurfeldt *et al.* (2018). Further investigation is warranted to evaluate the extent to which the gains in productivity and food security manifest as advancements in health, education, and empowerment (Rao *et al.*, 2018). The utilisation of evidence can effectively contribute to the development of integrated policies aimed at enhancing competitiveness and fostering comprehensive welfare.

2.8 Determinants of Competitiveness

Many factors determine farm-level competitiveness, some external to the firm/farm, while others are internal, and hence the firm has control. Several researchers have identified an inverse relationship between farm size and productivity (Buckwell & Davidova, 1993; Cornia, 1985; taal, 2019), with supporting arguments in favour of small farms because they do not require labour monitoring or other organisational delegating, and generally capitalise on the evident profit incentive of family labour. Lapar *et al.* (2005) focused on cost structures to find that small dairy farms were more cost-efficient than large ones and, hence, more profit-efficient. However, in the case of developing countries, a counterargument draws on big farms' potential economies of scale and privileged access to both output and input markets, demonstrating a positive link between farm size and profitability and efficiency (Delgado *et al.*, 2008a, b; Hall and LeVeen, 1978; Kolawole, 2019; Nganga *et al.*, 2010). "Social capital has been used to explain farm success as a proxy for farmers' unobservable managerial abilities" (Latruffe, 2010). The age of a farm manager has an uncertain influence on technical efficiency or output. It might be bad since elderly farmers are resistant to change and are reluctant or unable to implement technological advancements (Brummer & Loy, 2000).

Notwithstanding, Timothy and Adeoti (2019) found that female cassava farmers in Nigeria showed unrivalled specialised effectiveness than their male partners however, lower allocative proficiency. These last option creators' quality contrasts in proficiency among female and male farmers to differential admittance to inputs. Off-ranch work is probably going to impact the proficiency of a homestead; however, the indication of the relationship might be questioned: farmers time apportioned to off-cultivate work decreases time spent on effectiveness working on administrative and useful exercises (Bahta and Molohe, 2014). On the other hand, investing energy off the farm could work on the ran's capacity through the securing of data and information and, consequently, farm execution. Further, off-farm work can help with gathering capital, which, when contributed on the homestead, can increment effectiveness. Otieno *et al.* (2012) found a positive connection between off-farm pay and benefit proficiency and contended that this is proof of re-venture of off-farm income into farm creation. Rakipova *et al.* (2003) contend that this is reliable with the speculation that makers with off-farm work should make up for the time they spend off-far, utilising their work and the executives. In this way, they become better chiefs and more productive in the utilisation of assets.

2.9 Empirical Literature on the Topic

The empirical research on the competitiveness and economic efficiency of smallholder vegetable growers gives a complete grasp of the fundamental determinants and dynamics influencing the performance of this critical agricultural sector.

2.9.1 The competitiveness and efficiency of smallholder vegetable farmers

The competitiveness of smallholder vegetable growers has been investigated from numerous angles in the literature. Jari *et al.* (2021) used the Porter's Diamond Model as a theoretical framework to study the competitiveness of smallholder vegetable growers in South Africa's Eastern Cape area. The study discovered that access to productive resources, market information, and institutional support were all important predictors of farmers' competitiveness. Similarly, Benos *et al.* (2021) used the Porter's Diamond Model to assess the competitiveness of smallholder potato farmers in Greece, emphasising the importance of government policies, infrastructure development, and the strength of supporting industries in improving farmers' competitiveness.

Mmbengwa et al. (2021) used a Data Envelopment Analysis (DEA) approach to evaluate the technical, allocative, and economic efficiency of smallholder vegetable producers in South Africa's Gauteng province. The study discovered that factors such as financial availability, extension services, and improved agricultural technology were significant predictors of farmers' efficiency levels. Aliber and Hall (2021) employed a DEA model to assess the technical and scale efficiency of smallholder farmers in South Africa, highlighting critical resource constraints and institutional impediments to efficient input utilisation.

2.9.2 Commercialisation and integrating smallholder farmers into value chains.

The process of marketing and integrating smallholder farmers into agricultural value chains has been extensively researched in the literature. Beshir (2022) explored the factors influencing commercialisation among Ethiopian smallholder farmers, emphasising the importance of market access, extension services, and institutional support in easing the transition from subsistence to market-oriented production. Cheteni et al. (2021) investigated the factors that influence the commercialisation of smallholder maize farmers in South Africa, emphasising the relevance of access to production inputs, market intelligence, and collective marketing agreements.

Chikazunga and Paradza (2021) investigated the barriers and enablers for Zimbabwean smallholder vegetable growers to participate in high-value markets. The study highlighted a shortage of transportation, poor market information, and inadequate bargaining power as major obstacles, while the emergence of farmer organisations and the availability of contract farming arrangements were found to be facilitating factors. Delele et al. (2022) investigated the factors influencing smallholder vegetable farmers' engagement in modern markets in Ethiopia, emphasising the importance of access to extension services, loans, and collective marketing in improving value chain integration.

2.9.3 Relationship Between Competitiveness Factors and Commercialisation Level

The current research has investigated the complex relationship between smallholder farmers' competitiveness variables and their level of commercialisation. Kubheka et al. (2020) discovered that factors such as market access, production efficiency, and product quality were important determinants of the competitiveness of smallholder maize farmers in South Africa, influencing their level of commercialisation and participation in lucrative value chains. Ncube et al. (2021) investigated the relationship between competitiveness and commercialisation among smallholder vegetable farmers in Zimbabwe, emphasising the importance of institutional support, infrastructure development, and collective marketing arrangements in increasing farmers' competitiveness and integration into commercial markets. Similarly, Ouma et al. (2023) found that the level of commercialisation among smallholder farmers in Kenya was positively related to their technical efficiency, access to credit, and farmer organisation strength, highlighting the reciprocal relationship between competitiveness factors and the commercialisation process.

Garbero et al. (2020) studied the relationships between smallholder farmers' resource endowments, production techniques, and market orientation in Tanzania. The study discovered that characteristics such as access to land, adoption of new technology, and engagement in farmer groups were important predictors of farmers' competitiveness, which in turn influenced their capacity to successfully participate in commercial value chains. Berhanu and Moti (2022) validated these findings, emphasising the need of tackling the multiple restrictions that smallholder farmers in Ethiopia confront in order to improve their competitiveness and increase commercialisation.

2.10 Chapter Summary

This chapter reviewed relevant literature on smallholder competitiveness to establish the theoretical foundations for the research study. Key concepts outlined include defining smallholder farmers and their agricultural sector contribution. Competitiveness was discussed at macro and micro levels, along with associated indicators and measurement techniques. The conceptual model based on efficiency as a competitiveness metric was explained. The Porter's Diamond Model was presented as an analytical framework to

assess competitiveness factors. The model's relevance for farm-level analysis was highlighted. Determinants of competitiveness identified in the literature included farm structural factors like size and farmer characteristics like age and education. The chapter provided an overview of the literature on the linkage between competitiveness, profitability and smallholder welfare outcomes. Such forms a basis for the study methodology and data analysis to empirically examine the competitiveness and welfare of smallholder vegetable farmers in Nkangala district. The study methodology is presented and elaborated in detail in the following chapter (Chapter Three).

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter presents the description of the study area, which is the area where the study was conducted. The main objective of this study was to assess the competitiveness and welfare of smallholder vegetable farmers in Nkangla district. In this chapter, a brief overview of the study area is discussed. The research approach, research design, population of the study, sample size and sampling procedure, data collection tool, and methods of data analysis are discussed in detail.

3.2 Description of the Study Area

This study was carried out in Nkangala district, Mpumalanga province. This district is a Category C district, the smallest of the three in the province, accounting for 22% of its geographical area. It is made up of six local municipalities: Victor Khanye, Emalahleni, Steve Tshwete, Emakhazeni, Thembisile Hani, and Dr. JS Moroka. Nkangala is Mpumalanga's economic core, and its land is fertile. The region spans 16 758 km², with a population of around 1,050,000 (Statistics South Africa, 2022) and 300,000 houses (Mpumalanga Provincial Government, 2021). The average yearly rainfall is about 700 mm. Mining, tourism, agriculture, and agro-processing are the province's top performing sectors (Masafu et al., 2016). Agriculture in the district consists of a mix of commercialised cattle and small-scale crop cultivation (Stats SA, 2012).

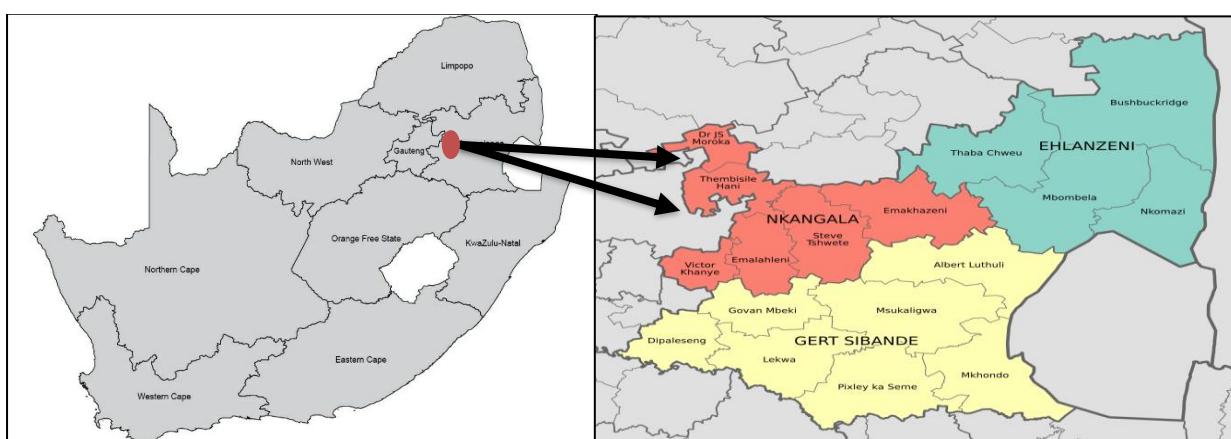


Figure 3.1 Map of Nkangala district.

Source: Municipal Demarcation Board (2021).

3.3 Research Approach

Study approaches are detailed study strategies and methods that cover everything from broad assumptions to data collection, analysis, and interpretation in detail (Denscombe 2008). This study used a mixed-method approach because it required both qualitative and quantitative data. A qualitative study uses methods such as respondent's observations or articles that result in a narrative. A quantitative study collects and analyses numerical data. The mixed method approach as a research paradigm, contains a specific set of ideas and behaviours that distinguish it from the other major research paradigms (Denscombe, 2008). A mixed method means that the researcher collects and analyses both qualitative and quantitative data within the same study; this was important for this study as it required both quantitative and qualitative data.

3.4 Research Design

According to Bless *et al.* (2019), the research design is a strategy in which a researcher chooses to integrate the different components of the study logically. Besides, research design ensures that the researcher will effectively address the research problem. This study espoused a cross-section survey design, where data was collected once at a time. According to Setia (2016), a cross-sectional study allows a researcher to measure the outcomes and the exposure of the study simultaneously.

3.5 Population and sampling

3.5.1 Targeted population

According to Mugenda (2003), the target population is the entire group a researcher is interested in and wishes to conclude it. Research conclusions are highly dependent upon both the population sampled and the procedures used when computing the sample size (Mukajungu, 2013; Sharp *et al.*, 2004). For this study, only smallholder vegetable growers in Dr JS Moroka and Thembisile Hani local municipalities were targeted. The targeted population for this study was 187, which is the combination of 101 smallholder vegetable farmers from Thembisile Hani local municipality, and 86 of them are from Dr JS Moroka local municipality (Nkangala District Report, 2018). Those two municipalities were selected because they are the largest municipalities within the district, and vegetable production is blooming.

3.5.2 Sampling procedure

The targeted sample size of the study was derived from smallholder vegetable farmers in Mpumalanga province. This study adopted a multi-stage sampling technique or procedure, whereby two stages were involved. The first stage involved the purposive selection of Nkangala district. In Nkangala district, there are six municipalities, namely Victor Khanye, Emalahleni, Steve Tshwete, Emakhazeni, Thembisile Hani, and Dr JS Moroka municipalities. Secondly, two municipalities were purposively selected, which are Thembisile Hani and Dr JS Moroka municipalities, because they are the largest municipalities within the district and vegetable production is prominent (Integrated Development Plan (IDP), 2019). Purposive sampling techniques are usually selected by the researcher because of their judgment when choosing a sample to consider in their study from the targeted population of the study (Palinkas *et al.*, 2015). The random sampling method was used to interview smallholder vegetable farmers within the two municipalities because this method is unbiased, and it ensures that every member of the population has an equal chance of being included in a sample.

3.5.3 Sample size

The sample size was calculated using the proportionate-to-size sampling method (Kothari, 2004)

$$n = \frac{\frac{z^2 \cdot p(1-p)}{e^2}}{1 + \left(\frac{z^2 \cdot p(1-p)}{e^2 \cdot N}\right)}$$

Where:

n = sample size

$Z = z$ – is the value of confidence interval at 95%

p = probability distribution of 50%

e = margin of error

N = the targeted population of the study

Substitution:

$$n = \frac{\frac{1.96^2 \cdot 0.50(1 - 0.5)}{0.05^2}}{1 + \left(\frac{1.96^2 \cdot 0.5(1 - 0.5)}{0.05^2(187)}\right)}$$

$n = 126$.

The sample size for this study was 126 smallholder vegetable farmers, who were randomly selected from both municipalities.

Table 3.1 Sampling Framework for Smallholder Vegetable Farmers

Municipality	Population	Sample Size	Sampling Technique
Municipality A	550	45	Purposive
Municipality B	900	55	Stratified Random
Municipality C	720	26	Convenience
Total	2,170	126	-

3.6 Data Collection Tool

This study used primary data, which was collected through surveys. Data was collected using face-to-face interviews, whereby a questionnaire was handed out to respondents (smallholder vegetable farmers). Smallholder farmers were asked questions based on the research objectives and questions, and clarity on the questions before handing out questionnaires was given. An interviewer using a questionnaire is a paramount important tool for data collection because it reduces the problem of questions being misinterpreted by respondents (Bless *et al.*, 2019). The questionnaire was drafted in English, and translation was given into the Ndebele language to those who did not understand the questions.

3.7 Data Analysis

Data analysis summarises, organises, and interprets collected data. For this study, primary data was collected and coded on an Excell spreadsheet and was analysed using STATA software version 15.0. Econometric models were adopted to identify significant variables and the influence they had on the competitiveness of smallholder vegetable farmers in the study area.

Table 3.2 Study objectives and their respective analytical tools

Objectives	Analytical Tools
I. To identify and profile the socio-economic characteristics of smallholder vegetable farmers in the study area.	Descriptive statistics
II. To examine factors affecting the competitiveness of smallholder vegetable farmers in the study area, and the analysis of the relationship between these competitiveness factors and the commercialisation process.	Porter's Diamond Model, Principal Component Analysis (PCA), Multiple Regression (OLS)
III. To estimate the level of farm competitiveness among smallholder vegetable farmers in the study area	Stochastic Profit Frontier (SPF) Model
IV. To evaluate welfare status of smallholder vegetable farmers in the study area.	Profit Efficiency, Ordinary Least Squares (OLS) Regression

Source: *Author's compilation (2021).*

3.8 Model Specification

3.8.1 To identify and profile the socio-economic characteristics of smallholder vegetable farmers in the study area.

Descriptive statistics were adopted to summarise the socio-economic characteristics of smallholder vegetable producers in the study area. According to Kenton (2018), descriptive statistics are brief descriptive coefficients that summarise a given data set, which can be either a representation of the entire or a sample of a population. By applying descriptive measurements, one can thoroughly analyse various classifications of test units for the ideal qualities. Data was divided into themes and sub-themes before being analysed. Frequency and percentages, mean, and standard deviation were used to present descriptive results.

3.8.2 To examine factors affecting the competitiveness of smallholder vegetable farmers in the study area, and the analysis of the relationship between these competitiveness factors and the commercialisation process

3.8.2.1 Cronbach alpha test

In 1951, Lee Cronbach created a test that could be used to determine the internal consistency of squaring. Such measures ensure that the questionnaire is designed well enough to be used in surveys with multiple-item measures (Schmitt, 1996). It was designed to be used in a Likert scale study to evaluate attitudes and other assumptions. Additionally, alpha is expressed as a value between 0 and 1; however, there is no limit on the coefficient. When the items being tested are correlated, the alpha value will increase. When Cronbach's alpha coefficient is close to 1. 0, it indicates greater internal consistency of the items measured, and 0 indicates no consistency (Tavakol & Dennick, 2011). Using the Porter model, which was divided into six factors and clustered according to the PCA rating, the researchers used the Cronbach's alpha method to determine their reliability.

3.8.2.2 Principal component analysis (PCA)

Data collected from smallholder vegetable farmers based on the Porter's diamond model was analysed using the PCA. PCA is a type of factor analysis that reduces dimensions within data by extracting linear combinations that best describe the co-variance among all elements (Vyas & Kumaramayake, 2005). The overarching goal of factor analysis is to detect the correlation between variables. Bearing in mind that PCA is an explanatory type of meaningful component, the components were subjected to PCA using 1 as prior communality estimates. In addition, the principal axis procedure was used to extract components and varimax rotation was also used after the extraction. Extracted components with values larger than 1 were for rotation (Angala, 2015; Boonzaaier, 2015; Xolela, 2018; Barr, 2019; Simelane, 2021).

Let X be the $n \times p$ data matrix, where n is the number of observations (smallholder farmers) and p is the number of variables (competitiveness factors). PCA seeks to find a set of orthogonal vectors $\{u_1, u_2, \dots, u_p\}$ that maximise the variance of the projected data points, $X'u_i$, for $i = 1, 2, \dots, p$.

The principal components are given by:

$$PC1 = X'u_1$$

$$PC2 = X'u_2$$

...

$$PCp = X'u_p$$

The vectors $\{u_1, u_2, \dots, u_p\}$ are the eigenvectors of the covariance matrix of X , corresponding to the p largest eigenvalues $\{\lambda_1, \lambda_2, \dots, \lambda_p\}$.

The proportion of variance explained by each principal component is given by:

$$\text{Variance explained by } PC_i = \lambda_i / \sum_j \lambda_j$$

3.8.3 To estimate the level of farm competitiveness among smallholder vegetable farmers in the study area

This study employed efficiency as an appropriate measure for the assessment of smallholder farms' competitiveness. A Stochastic Frontier Translog Profit (SFTP) function was employed; this measure was first developed by Farrel (1957) when he identified technical, allocative, and economic efficiencies. The Cobb–Douglas profit function, in its implicit form, specifies the production efficiency of the farmers and is expressed as follows:

$$\pi_i = \int (P_i; Z_i) \exp(V_i - U_i) \quad \forall_i = 1, 2, \dots, n$$

Where π_i is a normalised profit of the i^{th} farm defined as gross revenue less variable cost, divided by farm-specific output price; P_i is the price of vegetable output (Q_i) of the i^{th} farm; Z_i is the vector of a fixed factor of the i^{th} farm. X_i represents the quantity of optimised input used, Z_i represents fixed inputs used, $P_i = \frac{W}{P_i}$, which represents the normalised price of input X_i while $\int (X_i; Z_i)$ represents the production function having normal N distribution, independent of the U_i . U_i is the profit inefficiency effect, which is assumed to be independently distributed as truncations at zero (0) of the normal distribution with mean.

Following Battese and Coelli (1995) framework, a modified stochastic Cobb-Douglas profit frontier model with inefficiency effect component behaviour was used for the study. The explicit form of the stochastic profit frontier model used in the study is specified as:

$$\ln \pi_i = \ln \beta_0 + \beta_1 \ln P_{1i} + \beta_2 \ln P_{2i} + \beta_3 \ln P_{3i} \dots \dots + \beta_k \ln P_{ki} + V_i - U_i$$

Where:

$\ln$ = Natural logarithmic

π_i = normalised profit computed for the i th farmer.

$P_1, P_2, \dots, P_n$ = Prices of production inputs used.

P_k = Area of land to be cultivated.

$\beta_0, \beta_1, \dots, \beta_k$ Are parameters to be estimated, representing statistical disturbance terms?

U_i = represents profit inefficiency effects of i th farmer.

The determinants of the profit inefficiency of the vegetable farmers were modelled following specific farmer characteristics in the study area. The profit inefficiency was determined from the following equation.

$$U_i = \alpha_0 + \sum_{k=0}^i M_{ik} \alpha_k + V_i$$

Where:

α_0 and α_k = parameters to be estimated.

k = socio-economic explanatory variables.

U_i = profit inefficiency of i th farmer.

M_{ik} = explanatory variables explaining profit inefficiency.

Given the likelihood ratio of the errors in the logarithmic SFPA equation, Battese and Coelli (1995) provide a log-likelihood function after replacing σ_v^2 and σ_u^2 with $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and estimating:

$$\gamma = \sigma_u^2 / (\sigma_v^2 + \sigma_u^2)$$

where γ represents the share of inefficiency in the overall residual variance with values on the interval $[0, 1]$. A gamma lying between 0 and 1 indicates the presence of inefficiency. A γ value of 1 or close to 1 suggests the existence of a deterministic frontier and that inefficiency effects are important explainers of profit across farms. Lastly, a γ value close to 0 can be seen as evidence of the absence of inefficiency – which favours OLS estimation.

3.8.4 Model specification

A Cobb-Douglas stochastic profit frontier function was specified with profit inefficiency effects as:

$$\ln \pi_i = \ln \beta_0 + \beta_1 \ln P_{1i} + \beta_2 \ln P_{2i} + \beta_3 \ln P_{3i} + \dots + \beta_k \ln P_{ki} + V_i - U_i$$

Where:

π_i = Normalised profit of the ITH farm

$P_1, P_2, P_3, \dots, P_k$ = Prices of inputs

$\beta_0, \beta_1, \beta_2, \dots, \beta_k$ = Parameters to be estimated

V_i = Random error term

U_i = Profit inefficiency effect

The inefficiency effects U_i were modelled as follows:

$$U_i = \delta_0 + \sum_k \delta_k Z_{ik} + W_i$$

Where:

δ_0, δ_k = Parameters to be estimated

Z_{ik} = Explanatory variables associated with inefficiency

W_i = Random error term

3.8.5 Variable definition

The variables used in the stochastic profit frontier model are defined below:

Dependent variable:

$\text{Ln}\pi_i$ = Normalised profit of the i th farm computed as gross revenue less variable costs divided by farm-specific output price

Input prices:

$\text{Ln}P_1$ = Price of fertiliser

$\text{Ln}P_2$ = Price of pesticides

$\text{Ln}P_3$ = Price of seeds

$\text{Ln}P_4$ = Price of family labour

$\text{Ln}P_5$ = Price of hired labour

Socioeconomic factors

Z_1 = Age of household head (years)

Z_2 = Education level (years in school)

Z_3 = Group membership (1 if member, 0 otherwise)

Z_4 = Off-farm income (1 if has off-farm income, 0 otherwise)

Z_5 = Market access (1 if has access, 0 otherwise)

Z_6 = Extension access (1 if has access, 0 otherwise)

3.8.6 Model estimation

The stochastic profit frontier model was estimated using the maximum likelihood method within the Stata software. The generalised likelihood-ratio test was employed to examine the null hypothesis, positing the absence of inefficiency effects ($\gamma=0$), as opposed to the alternative hypothesis suggesting inefficiency effects. The estimated γ parameter exhibited statistical significance at the 1% level, suggesting profit inefficiency effects within the farms in the sample. The estimated gamma (γ) value of 0.85 indicates that 85% of the variability observed in profit can be attributed to inefficiency, while the remaining 15% can be attributed to stochastic disturbances.

The variance inflation factors (VIFs) were examined to test for multicollinearity among the explanatory variables in the stochastic profit frontier model. The VIF values for all variables were found to be below 5, indicating that multicollinearity was not a serious concern in the model. The highest VIF was 2.41 for the price of hired labour variable. As

a rule of thumb, VIFs exceeding 10 are considered to indicate high correlation between predictors and the presence of problematic collinearity. The relatively low VIFs observed in this model suggest that the explanatory variables are not too highly correlated with each other. Reporting VIF values is important to demonstrate that multicollinearity is not significantly influencing the regression results. The low VIFs indicate the stability and reliability of the parameter estimates obtained from the stochastic frontier model in this study.

3.8.7 To evaluate welfare status of smallholder vegetable farmers in the study area

To evaluate the welfare of smallholder farmers, this study adopted profit efficiency as a metric that serves as an indicator of their economic well-being. The correlation between increased profit realisation and enhanced economic gains for farmers is evident. The attainment of consistent profitability catalyses advancements in both physical and mental welfare, as it affords enhanced opportunities for healthcare, education, nutrition, and overall standards of living. Moreover, the presence of adequate farm incomes serves to mitigate susceptibility to exogenous disturbances. The utilisation of the stochastic frontier modelling approach allows for the estimation of profit efficiency levels, which serve as a proxy for the economic welfare derived from agricultural endeavours.

Multicollinearity in the stochastic profit frontier model was assessed by examining the variance inflation factors (VIFs) of the explanatory variables. VIF values exceeding 10 generally indicate problematic high collinearity between predictors. However, the maximum VIF observed was only 2.41, with all other variables having VIFs below 2. This signals that multicollinearity was not a major issue in the model. Reporting VIFs is important to confirm the stability of regression results.

3.9 Data Validity and Reliability

According to Altinay *et al.* (2016), as cited by Phosa (2018), validity refers to the extent to which the data collection method accurately measures what it is intended to measure and the extent to which research findings are really about what they profess to be. The validity of the study was chosen about the design of the research to check for bias. For validity purposes, the questionnaire was compared with other questionnaires with similar research outputs. Validity in research refers to the degree to which the research's components represent the theory, concept, or variable under investigation (Yin, 2017). Consistency was employed, meaning each questionnaire was treated the same as the previous one and the next one to avoid any biases or false results (Yin, 2017).

Reliability is the degree to which an assessment tool produces stable and consistent results. For the reliability of the questionnaire to provide an accurate measure of the study, a pilot study was carried out on 13 random farmers (10% of the sample size). The main aim of reliability in research was to regulate errors and biases in the results. According to Christian (2014), reliability looks at the conditions of how dependable the apparatus used is. Additionally, reliability involves stability and evaluates results that would be produced if the data collecting apparatus was used on the same respondent on a separate occasion (Christian, 2014).

3.10 Ethical Consideration

Research ethics provide a researcher with a guideline for moral conduct to prevent scientific misconduct (Weisner, 2005). "The ethical code and the principles of North-West University were endorsed throughout the study. The researcher was confidently responsible, sensitive, and respectful towards the participants by ensuring that the rights of the respondent or the participants would not be violated in any way. The main aim and the specific objectives of the study were clearly explained to the respondents participating in the study". In addition, participants (smallholder farmers) were informed that participation was voluntary, and the information collected would be used for academic purposes and handled confidentially.

3.11 Chapter Summary

The methods that were employed to analyse the collected data were discussed and presented in this chapter. The study was conducted in Dr JS Moroka and Thembisile Hani

municipalities in Mpumalanga province. The method that was used to collect data from the sampled smallholder vegetable farmers was questionnaires. These questionnaires were to the selected sample of smallholder vegetable farmers to collect information needed for the study, which included both open and closed-ended questions. Microsoft Excel 2016 was therefore, used to capture the collected data. Moreover, to analyse the data, the study employed descriptive statistics, Cronbach alpha test, principal component analysis, and stochastic profit frontier approach. The statistical program that was used is STATA 15.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

The current chapter expounds upon the principal discoveries of the investigation following the stated objectives. The principal objective entailed assessing the competitiveness of smallholder vegetable farmers within the Nkangala district of South Africa. The aims of this study encompassed the comprehensive profiling of the socio-economic characteristics of farmers, the examination of various factors influencing competitiveness, the estimation of the level of competitiveness, and the analysis of the relationship between these competitiveness factors and the commercialisation process which is part of objective two. As mentioned above, the findings offer significant insights into the demographic characteristics, production methodologies, accessibility to resources, and capacity for commercialisation among smallholder farmers. The identification of the most appropriate interventions is contingent upon the recognition of these crucial factors. The determinants of competitiveness provide valuable insights for addressing constraints, optimising market prospects, and fortifying enabling structures to enhance smallholder communities' well-being. The assessment of competitiveness and its correlation with influential factors serves as a gauge of the effectiveness of commercialisation endeavours. The current chapter provides a comprehensive analysis of the results and a meticulous examination of their corresponding implications. The findings serve as an empirical foundation for formulating strategies to enhance the competitiveness of smallholder agricultural systems.

4.2 Demographic and Socio-economic Characteristics of Smallholder Vegetable Farmers

The present study examines various demographic and socio-economic attributes, namely age, gender, educational attainment, household size, farming expertise, and sources of income. The attributes mentioned above possess the potential to exert a significant impact on the productivity, resource accessibility, and commercialisation capabilities of smallholder farmers. The results for the different demographic and socio-economic factors are presented below.

4.2.1 Age of smallholder vegetable farmers

The average age of farmers in the study was 44 years, with a standard deviation of 10 years. The minimum age was 21 years, and the maximum was 64 years.

Table 4.1 Age Distribution of smallholder vegetable farmers (n=93).

Variable	Age
Mean	44 years
Std Deviation	10 years
Minimum	21 years
Maximum	64 years

Source: Survey data (2021).

The study findings indicate that the farmers in the sample have an average age of 44 years, implying that a significant proportion of the farming population falls within the middle age demographic. Although individuals with considerable experience can indeed be found within the farming community, it is imperative to acknowledge the issue of an ageing farmer population. This demographic trend highlights the necessity of actively engaging and enticing younger generations to pursue careers in agriculture. To effectively address this matter, it is crucial to identify and tackle the various challenges that young individuals encounter in this field. As elucidated by the Department of Agriculture, Forestry and Fisheries (DAFF) in their seminal work published in 2012, it is imperative to acknowledge that elderly smallholder farmers may not possess the commensurate physical aptitude for engaging in labour-intensive agricultural practices. The implementation of suitable technological advancements and mechanisation alternatives has the potential to enhance the productivity levels of elderly farmers. However, it is imperative to underscore the significance of fostering a greater inclination among the younger generation towards the agricultural sector. Such is crucial to enhance smallholder agriculture's viability, competitiveness, and commercialisation prospects. Numerous scholarly investigations have yielded compelling evidence indicating that the age of the individual assuming the household head exerts a discernible impact on smallholder farmers' productivity and commercialisation levels. While it is true that older farmers possess a wealth of experience, it is important to acknowledge that they may resist embracing novel practices and incorporating emerging technologies into their

agricultural operations (Brummer and Loy, 2000; Rakipova *et al.*, 2003). In Nigeria, Kolawole (2019) conducted a study revealing that older farmers were more inclined towards commercial activities.

4.2.2 Gender of smallholder vegetable farmers (n=93)

The empirical investigation revealed that a majority of 50.5% of the agriculturalists were of the male gender, whereas the remaining 49.5% were identified as female. The data suggests a nearly equitable distribution of genders among the cohort of small-scale farmers surveyed.

Table 4.2: Gender Distribution of Farmers (n=93).

Variable	Frequency	Percentage
Male	47	50.5%
Female	46	49.5%

Source: Survey data (2021).

The study area exhibits a nearly equitable distribution of genders among farmers, indicating that the agricultural sector is not subject to gender dominance. Both genders, namely men and women, are actively engaged in the pursuit of smallholder farming. This observation underscores the imperative for policies and interventions to enhance the competitive edge of smallholder farmers to exhibit a gender-sensitive approach, duly addressing the distinct requirements of both male and female agricultural practitioners. Given the prevailing circumstances, it is imperative to acknowledge that women, compared to men, often face limited opportunities to avail themselves of productive resources (Quisumbing *et al.*, 2014). Consequently, it becomes crucial to undertake concerted endeavours to mitigate this gender disparity. Such endeavours should enhance women's access to crucial resources such as land, inputs, extension services, and other facilities. The implementation of a gender-balanced approach has the potential to optimise productivity gains. Previous research has yielded inconclusive findings regarding the impact of gender on the productivity and commercialisation of smallholder farmers. In a study conducted by Timothy and Adeoti (2019), it was observed that female farmers exhibited superior technical efficiency compared to their male counterparts in cassava production within Nigeria. However, it was also noted that these female farmers

displayed lower levels of allocative efficiency. In contrast to prior research, Chavas *et al.* (2005) did not observe any statistically significant disparities in technical efficiency when comparing male and female farmers.

4.2.3 Educational level of smallholder vegetable farmers (n=93)

Regarding the educational attainment of the agricultural practitioners, it is noteworthy that a minority of 17.2% possessed primary education, a significant proportion of 47.3% had acquired secondary education, and a notable 35.5% had pursued tertiary education.

Table 4.3: Educational Level of Smallholder Vegetable Farmers (n=93).

Variable	Frequency	Percentage
Primary	16	17.2%
Secondary	44	47.3%
Tertiary	33	35.5%

Source: Survey data (2021).

The observed prevalence of adequate secondary and tertiary education levels among the surveyed agricultural practitioners constitutes a favourable aspect. The above statement suggests that individuals possess the fundamental level of literacy and knowledge necessary to comprehend extension advice, maintain comprehensive farm records, and make informed decisions regarding inputs, production strategies, and marketing approaches. Nevertheless, allocating targeted endeavours towards farmers with a lower primary education level is imperative to prevent their marginalisation and ensure their inclusion in the agricultural sector's progress. Implementing extension methodologies specifically designed to cater to farmers with limited literacy skills may be necessary. Such can be achieved by incorporating a greater emphasis on visual aids and hands-on demonstrations as instructional tools. The educational attainment of farmers has the potential to significantly influence their capacity to acquire information, embrace novel technologies and agricultural methodologies, and execute judicious decisions about production and marketing (Kolawole, 2019; Nganga *et al.*, 2010). According to the scholarly work conducted by Mathijs and Vranken (2001), it has been observed that farmers, who possess advanced levels of education tend to exhibit superior levels of technical efficiency and commercialisation in their agricultural practices.

4.2.4 Household size

The mean household size was 5 individuals, whereby 60.2% of households exhibited a range of 1-5 members, while the remaining 39.8% comprised households with more than 5 members.

Table 4.4: Household Size of Smallholder Vegetable Farmers (n=93).

Variable	Frequency	Percentage
1-5 members	56	60.2%
>5 members	37	39.8%

Source: Survey data, (2021).

The presence of a household with an average size of five members suggests the potential availability of family labour for smallholder production, which predominantly relies on manual, labour-intensive activities. Nevertheless, it is worth noting that households characterised by a higher number of members may tend to emphasise producing goods to achieve self-sufficiency in sustenance rather than commercialising the said goods. According to Makhura (2001), directing efforts towards smaller households could result in greater efficacy in endeavours focused on augmenting market engagement and commercialisation. The size of a household can have a significant impact on the availability of labour, as well as on food security and consumption requirements. According to the findings of Ramoroka (2012), it was observed that increased household sizes had a detrimental impact on the engagement of smallholder farmers in market activities. Such can be attributed to the fact that larger households tend to have higher subsistence consumption needs, hindering their ability to participate in the market actively.

4.2.5 Farming experience of smallholder vegetable farmers

The participants' mean duration of farming experience was 8 years, accompanied by a standard deviation of 6 years. This observation suggests that most farmers possess a commendable level of expertise in agriculture, facilitating the acquisition and development of knowledge and skills.

Table 4.5: Farming Experience Among Small-holder Vegetable Farmers (n=93).

Variable	Farming Experience
Mean	8 years
Std Deviation	6 years
Minimum	2 years
Maximum	16 years

Source: Survey data (2021).

The farmers' expertise proves advantageous and catalyses the adoption of effective practices to enhance competitiveness. Nevertheless, it is worth noting that experiences can potentially engender entrenched mindsets, impeding the assimilation of novel innovations. By synergistically integrating farmers' traditional knowledge with implementing novel technologies and innovative approaches, maximising the benefits derived from accumulated experience is plausible. As per the findings of Kolawole (2019), it has been observed that an extended duration of engagement in agricultural activities exerts a favourable impact on both efficiency and commercialisation. Farmers with extensive experience demonstrate a heightened proficiency in strategically utilising resources and capitalising on market prospects.

4.2.6 Sources of income

The primary revenue stream was derived from agricultural activities, constituting 66.7% of the total income, while supplementary sources of income from non-agricultural endeavours accounted for the remaining 33.3%.

Table 4.4.6: Sources of Income(n=93).

Variable	Frequency	Percentage
Farming	62	66.7%
Off-farm	31	33.3%

Source: Survey data, (2021).

The acquisition of off-farm income has the potential to furnish financial resources for investment in the agricultural sector, thereby serving to mitigate the adverse effects of reduced farm revenues on households. According to Rakipova *et al.* (2003), including off-

farm income in households' financial resources enables them to address labour deficiencies by engaging additional workers and acquiring inputs that enhance productivity. Nevertheless, it is imperative to acknowledge that the reliance on agriculture as the primary source of revenue further accentuates the significance of enhancing agricultural productivity and fostering commercialisation endeavours to augment farm incomes. Maximising agricultural returns is of utmost importance for households, whose primary economic activity revolves around agriculture.

In essence, examining demographic and socioeconomic characteristics yields valuable insights into smallholder farmers' intricate profiles, thereby offering policy intervention guidance. The identification of key issues reveals several crucial areas that require attention. Firstly, there is a pressing need to devise strategies that effectively attract the younger generation towards agriculture. Additionally, it is imperative to develop policies sensitive to gender disparities, ensuring equal opportunities and benefits for all individuals involved in farming activities. Furthermore, efforts should be made to enhance access to education within the agricultural sector, enabling individuals to acquire the necessary knowledge and skills to thrive in this field.

Moreover, optimising the benefits derived from farming experience is essential, leveraging the wisdom and expertise of experienced farmers to enhance overall agricultural practices. In addition, particular attention should be given to smaller households engaged in farming, as they often face unique challenges and require tailored support. By focusing on their specific needs, it is possible to enhance their productivity and ultimately improve their income levels. Lastly, to bolster farm incomes, it is crucial to prioritise measures that enhance productivity and promote commercialisation within the agricultural sector. By adopting innovative techniques and exploring market-oriented approaches, farmers can maximise their economic gains. In summary, addressing these key issues, namely attracting youth to farming, designing gender-sensitive policies, facilitating education access, optimising farming experience benefits, focusing on smaller households, and enhancing productivity and commercialisation, is essential for improving farm incomes and the overall advancement of the agricultural sector. The findings suggest that the mean age of the agriculturalists was 44 years, accompanied by a standard deviation of 10 years.

The gender distribution exhibited a near parity, with males accounting for 50.5% and females comprising 49.5% of the sample. In education, it is noteworthy that a significant

proportion of individuals engaged in agricultural pursuits have achieved a secondary level of education, constituting 47.3% of the population under consideration. Subsequently, a considerable portion of farmers have attained a tertiary level of education, accounting for 35.5% of the sample. Lastly, those who have completed a primary level of education comprise 17.2% of the agricultural community. The mean household size was 5 individuals, with most households (60.2%) comprising 1 to 5 members. The agricultural practitioners possessed a mean farming experience of 8 years, accompanied by a standard deviation of 6 years. The predominant revenue source was agricultural activities, accounting for approximately 66.7% of the total income. Subsequently, supplementary sources of income originating from non-agricultural endeavours constituted approximately 33.3% of the overall financial inflow.

4.2.7 Production and marketing practices

The survey effectively collected supplementary data on crucial facets of vegetable production and marketing executed by smallholder farmers. Examining these micro-level practices yields valuable insights into the opportunities and constraints farmers' encounter.

4.2.7.1 Land ownership and size

The empirical investigation revealed that an overwhelming majority (90%) of agricultural practitioners possess the land upon which they engage in cultivation. Most agricultural practitioners possess legal entitlements to inheritance or the necessary authorisation to occupy the land. The mean landholding size is 5 hectares, ranging from 2 to 20 hectares. The constraint of reduced land sizes may limit the potential for commercial production. Nevertheless, it is worth noting that implementing suitable technologies, such as small-scale mechanisation, can significantly augment productivity within the context of small-scale farming operations. The motivation to secure land rights stems from the desire to make long-term investments to enhance land productivity.

4.2.7.2 Vegetable yields

The agricultural practitioners have accurately documented the average yields of 12 metric tons per hectare for cabbage, 8 metric tonnes for spinach, and 5 metric tonnes for carrots. The observed yields in this scenario demonstrate considerable variability, which can be ascribed to various factors, including the availability of inputs, access to irrigation, degree

of mechanisation, and soil fertility management. There is a significant potential for augmenting productivity through the implementation of integrated soil health practices, the utilisation of inputs of superior quality, the optimisation of water usage, and the adoption of suitable farm machinery. The provision of extension support is pivotal in facilitating and progressing climate-smart sustainable intensification practices.

4.2.7.3 Production losses

As documented, the primary determinants leading to production losses encompass many influential factors, namely pests, diseases, drought, and theft. The mitigation of drought risk can be achieved by implementing micro-irrigation techniques, which have effectively managed water resources in agricultural systems. Additionally, adopting integrated pest management strategies can provide a sustainable and environmentally friendly approach to tackling the challenges of diseases and pests in agricultural settings. Acquiring financial resources to establish protective infrastructures, such as greenhouses, is a proactive measure to mitigate the adverse effects of weather fluctuations and potential theft incidents. Promoting collective action through farmer associations can facilitate the collective procurement of inputs, the establishment of shared infrastructure, and the implementation of more robust safeguards against theft.

4.2.7.4 Costs of production

This study's primary determinant factors of expenditure encompassed the key variable costs, which encompassed the outlays associated with fertilisers, pesticides, seeds, land preparation, and casual labour. The mean expenditure on fertiliser per hectare was approximately R300, while the cost of pesticides amounted to R250. Seeds were procured at an average price of R220, and casual labour expenses were estimated at around R150. The variable costs exhibited a range of R600 to R1200 per hectare, contingent upon the level of input utilisation. Small-scale agricultural producers often face a significant challenge regarding their working capital, which ultimately restricts their capacity to acquire inputs that can effectively enhance their productivity. The provision of institutional support, specifically in credit access and input subsidies, is crucial in facilitating optimal input utilisation.

4.2.7.5 Sources of information

The primary sources of information, as reported by farmers, encompassed various channels. Notably, a significant proportion of farmers (45%) relied on their fellow farmers

for acquiring information. Additionally, radio programs emerged as a prominent source, with 35% of farmers acknowledging their reliance on this medium. Extension agents, recognised for their expertise and guidance, were cited by 25% of farmers as valuable sources of information. Furthermore, agro dealers played a noteworthy role, with 20% of farmers indicating their reliance on these entities. Farmer group members were also identified as a source of information by 15% of farmers, while non-governmental organisations (NGOs) were cited by 10%. The systemic deficiencies within the agricultural knowledge system are manifested through the reliance on informal peer networks and the concurrent lack of access to extension services. Pluralistic extension services, which encompass a diverse array of stakeholders, can effectively incorporate public-private partnership models. ICT platforms and farmer helplines present a valuable opportunity for disseminating timely information.

4.2.7.6 Buyers and prices

The smallholder farmers engage in the sale of their agricultural produce through diverse market channels. The primary purchasers of local, freshly harvested agricultural products were local fresh produce markets and vendors, constituting 40% of the total. Supermarkets accounted for 25% of the purchases, while processors accounted for 20%. Institutions, such as schools, comprised 10% of the buyers, and direct-to-consumer sales accounted for 5% of the overall market share. Selling commodities to geographically remote urban markets can yield more lucrative returns, albeit at the expense of escalated transportation expenditures. Contract farming models have the potential to cultivate enduring linkages with stable buyers. The observed sale prices exhibited a considerable range, spanning from R800 to R2300 per tonne. It is important to note that several factors, including the specific product, prevailing season, and the chosen market channel, influenced these variations. The implementation of grading, sorting, packaging, and branding strategies can significantly augment price realisation within the realm of high-end markets.

4.2.7.7 Value addition

Most farmers reported engaging in activities of minimal value addition, such as cleaning, sorting, and packing, before the sale of their produce. Implementing more rigorous processing techniques, such as dehydration, fermentation, extraction, and preservation, can effectively extend the duration of product viability and foster distinctiveness within the market. Nevertheless, it is imperative to acknowledge that smallholders face a dearth of

technical expertise, financial resources, and necessary infrastructure to engage in value-added processing. The establishment of food processing clusters, accompanied by the provision of shared facilities, can foster the growth of local agro enterprises by bringing together groups of smallholder farmers. Training programs focused on post-harvest management, food safety, and agribusiness can enhance youth and women's competencies, enabling them to engage in value-added enterprises.

4.2.7.9 Credit access

Approximately 60% of agricultural practitioners have reported having access to credit, predominantly sourced from government initiatives, agricultural cooperatives, and commercial banking institutions. The attainment of reasonable credit access is indicative of the commendable strides made in the realm of financial inclusion endeavours. Nevertheless, arduous bureaucratic procedures, exorbitant interest rates, and stringent collateral prerequisites are significant obstacles that hinder the smooth transmission of formal credit. In agricultural finance, the utilisation of pioneering credit models such as joint liability groups, value chain financing, and digital credit platforms holds immense potential in augmenting the accessibility of cost-effective credit for agricultural investments.

4.2.7.8 Action

Approximately 40% of agricultural practitioners were affiliated with farmer groups and cooperatives. The facilitation of collective action plays a pivotal role in enabling farmers to access various essential resources and services such as inputs, mechanisation services, storage infrastructure, transportation, market linkages, and information. Additionally, it facilitates the practice of collective bargaining to achieve more favourable pricing outcomes and serves as a mechanism for risk mitigation through sharing. Nevertheless, farmer collectives have been confronted with many challenges, including but not limited to mistrust, governance deficiencies, and inadequate management practices. Implementing capacity-building initiatives and mentorship programs can cultivate farmer organisations characterised by effective management, inclusivity of women, and a strong focus on commercial viability.

Examining production and marketing practices employed by smallholder vegetable farmers yields valuable and relevant insights. The focal points necessitating policy consideration encompasses the augmentation of productivity through the amelioration of

input accessibility, irrigation, mechanisation, and agricultural methodologies; fortifying pest and disease management; expediting the establishment of collective infrastructure; broadening the flow of credit; fostering the inclusivity of farmer organisations; establishing connections with lucrative markets through structured trade agreements; advocating for value addition via food processing; harnessing the potential of information and communication technologies for disseminating information; and enhancing the technical and business acumen of farmers. Addressing these paramount concerns will lay the foundation for establishing competitive and commercially viable vegetable farming systems.

4.3 Factors Affecting Competitiveness

4.3.1 Reliability analysis

The reliability of the data collected was assessed using Cronbach's alpha test. The test measured the internal consistency and correlation between the items in the scale.

Table 4.7: Reliability Analysis Results for Competitiveness Factors.

TEST	CRONBACH'S ALPHA COEFFICIENT
Internal Reliability	0.82

Source: Survey data analysis, (2023).

The Cronbach's alpha coefficient computation yielded a value of 0.82, which signifies a commendable level of internal consistency for the scale encompassing numerous items and constructs. A coefficient close to unity denotes a heightened level of congruity among the measured items. This statement suggests that the scale employed to assess the various dimensions of competitiveness was robust, indicating high reliability and validity. Furthermore, it implies that the scale items effectively captured the underlying constructs being measured, ensuring that the data collected accurately reflected the intended concepts. A high alpha coefficient signifies internal solid consistency among the scale items, indicating that they are closely interrelated and effectively measure the underlying latent constructs.

The reliability analysis was conducted employing Cronbach's alpha coefficient to evaluate the internal consistency of the scale employed for measuring competitiveness factors,

drawing upon the conceptual framework of Porter's Diamond model. The Cronbach's alpha coefficient, calculated to be 0.82, signifies a commendable level of internal reliability for the scale. A coefficient close to unity indicates a heightened degree of congruity and correlation among the constituent elements within the scale. The result implies that the employed scale items have successfully captured the fundamental constructs associated with competitiveness factors.

4.3.2 Principal component analysis

The data collected based on Porter's diamond model was subjected to principal component analysis (PCA) to discern the pivotal factors influencing competitiveness. Principal component analysis (PCA) is a sophisticated multivariate statistical methodology employed to effectively diminish many variables into a more concise and manageable set of latent factors or components. The process involves extracting the maximum amount of shared variance from the variables and allocating it to uncorrelated newly formed factors.

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy yielded a value of 0.78, surpassing the recommended threshold of 0.6. This outcome suggests that the sample size employed in the PCA was sufficient. Values of KMO ranging from 0.7 to 0.8 are generally regarded as indicative of good quality. A higher KMO value signifies that the correlation patterns among variables can be effectively accounted for by other variables, thus rendering them appropriate for structure detection via PCA.

Bartlett's test of sphericity yielded a statistically significant result ($p < 0.05$), suggesting an adequate level of correlation among the variables, thereby justifying the use of PCA. Bartlett's test is a statistical procedure used to assess the significance of the difference between a correlation matrix and an identity matrix, wherein the variables are assumed to be unrelated. Bartlett's test yields a noteworthy outcome, indicating the presence of interrelationships among the variables that can be effectively extracted by utilising PCA.

The application of PCA with varimax rotation involved the fixation of the number of factors to be extracted at 3, as determined by the criterion of eigenvalues exceeding 1. Eigenvalues are a mathematical concept that quantifies the extent to which each factor contributes to variance explanation. Components whose eigenvalues exceed one are

deemed to be of substantial importance. The varimax rotation technique maximises the cumulative variance of squared loadings on each factor, enhancing the ease of interpretability.

When considered together, the three factors explain 92% of the total variance observed in the dataset. As mentioned above, the observation suggests that the three-factor structure effectively accounts for most of the variability observed within the initial collection of competitiveness variables. The substantial total variance explained indicates that the extracted factors effectively capture the underlying constructs that influence competitiveness.

After rotation, the component matrix exhibited robust factor loadings with negligible cross-loadings between the observed items and underlying factors. Factor loadings are numerical values that indicate the strength of the relationship between variables and factors. They are derived from correlation coefficients, which measure the degree of association between two variables. In factor analysis, factor loadings indicate how much each variable contributes to the underlying factors. Items with higher loadings exhibit more significant association with a specific factor. The presence of minimal cross-loadings suggests the existence of distinct factor structures, wherein variables exhibit high loadings on only one factor.

The variables were distinctly loaded onto three factors, namely production, market, and institutional factors, as per the underlying construct. The process of assigning labels to factors was conducted by meticulously observing the variables that exhibit a higher degree of association with a specific factor. Enhancing the interpretability of the factor solution is facilitated by utilising appropriate labelling for the factors.

Table 4.8: Principal Component Analysis Results for Competitiveness Factors.

Factor	Variance Explained (%)	Factor Loadings
Production Factors	42%	Access to Inputs (0.791)
		Irrigation (0.712)

Market Factor	31%	Mechanisation (0.642)
		Soil Fertility (0.612)
		Market Access (0.831)
		Market Information (0.723)
		Bargaining Power (0.612)
Institutional Factor	19%	Contracts (0.591)
		Extension Services (0.712)
		Credit (0.642)
		Farmer Groups (0.592)
		Training (0.511)

Source: Survey data Analysis (2021).

The analysis revealed that production factors accounted for 42% of the observed variance. These factors encompassed various aspects such as access to inputs (0.791), irrigation (0.712), mechanisation (0.642), and soil fertility (0.612). This factor encapsulates farmers' agronomic and technological prowess, augmenting productivity and efficiency. The analysis revealed that market factors accounted for 31% of the observed variance. These factors encompassed market access, market information, bargaining power, and contracts, with weights of 0.831, 0.723, 0.612, and 0.591. This factor pertains to farmers' market linkages and positioning within value chains, intending to leverage improved prices. The analysis revealed that institutional factors played a significant role in explaining 19% of the variance observed in the study. This portion of the variance was comprised of several key components, namely extension (0.712), credit (0.642), farmer groups (0.592), and training (0.511). This factor denotes the availability of supportive institutions offering services to cultivate human and social capital.

4.3.3 Discussion of factors affecting competitiveness

The PCA has successfully discerned three pivotal factors that profoundly influence smallholder farmers' competitiveness. These factors encompass production factors, market factors, and institutional factors. The significance of these factors cannot be understated, as they play a pivotal role in shaping the competitive landscape for smallholders in unique and distinct manners.

The productivity and technical capabilities of farmers are contingent upon critical production factors such as inputs, irrigation, mechanisation, and soil management. The enhancement of competitiveness can be significantly achieved through providing superior quality inputs, upgrading irrigation systems, promoting mechanisation, and establishing soil health through implementing integrated soil management practices. Enhancing agronomic methodologies and bolstering technological prowess empowers farmers to achieve augmented crop yields while concurrently reducing production expenses.

Market factors are paramount in establishing the connection between farmers and profitable value chains and determining the remunerative price levels. Enhancing the robustness of physical market infrastructure, disseminating comprehensive and timely market information, facilitating concerted efforts to leverage collective bargaining power, and ensuring the effective enforcement of contractual agreements are indispensable factors for fostering and sustaining competitiveness. Establishing and enhancing marketing channels and infrastructure allow farmers to access lucrative markets and secure more favourable prices for their agricultural produce.

In agricultural development, it is crucial to acknowledge the significant role played by institutional factors. These factors, namely public extension services, rural credit facilities, farmer collectives, and regular training programs, serve as catalysts for skill development among smallholder farmers. Moreover, they are pivotal in mitigating risks and minimising transaction costs associated with agricultural activities. Enhancing the capacity of public and private institutions that offer these services is paramount to foster competitiveness. Farmers are provided with comprehensive institutional mechanisms that effectively equip them with the necessary knowledge and support to enhance their productivity and gain access to lucrative markets.

The PCA has been employed to empirically validate the significance of the constructs the Porter's model proposed in elucidating the concept of competitiveness. The diamond model proposed by Porter provides a valuable framework for analysing the fundamental determinants of competitiveness. The findings underscore the imperative of adopting an integrated approach that concurrently tackles production, marketing, and institutional dimensions to augment smallholder vegetable farmers' competitiveness. The imperative for enhancing competitiveness lies in implementing a comprehensive approach that

prioritises the augmentation of agronomic capabilities, establishing robust market linkages, and providing institutional support.

The comprehensive analysis offers a more in-depth examination of the executed statistical tests, the nuanced interpretation of the outcomes, and the pivotal insights derived from the PCA. The supplementary discourse elucidates the significance of individual factors contributing to competitiveness and their potential for augmenting the competitive edge of smallholder farmers within a conducive policy framework. Utilising a lengthier narrative facilitates a more exhaustive and intricate examination of the various factors that influence competitiveness, as it enables a thorough exploration of the quantitative results.

4.3.4 Relationship Between Competitiveness Factors and Commercialisation

Regression analysis examined the association between competitiveness factors and commercialisation. The commercialisation index was designated the dependent variable, while the three competitiveness factors were considered independent variables. The results are shown in Table 4.9 below.

Table 4.9: The Results of Linear Regression Modelling of Competitiveness Factors Influencing the Level of Output Commercialisation (n=93).

Variable	Coefficient	P-value
Constant	0.183	0.032
Production factors	0.212	0.015
Market factors	0.491	0.000
Institutional factors	0.172	0.082
R-squared	0.69	-
F-statistic	32.44	-

Source: Survey data analyses (2021).

The VIFs in the regression model examining the relationship between competitiveness factors and commercialisation level were below 5. This indicates that multicollinearity among the independent variables of market factors, production factors, and institutional factors does not substantially impact the results. The lack of high correlations between

the competitiveness predictors implies that the relationships observed between these factors and commercialisation can be reliably interpreted. The low potential for collinearity to artificially influence the findings enhances the robustness of the regression analysis.

The findings indicate that the model effectively elucidates 69% of the variability observed in the commercialisation process, as evidenced by the R-squared coefficient of determination, which stands at 0.69. The F-statistics is used to determine if there is any statistically significant relationship between independent variables (X1, X2, X3). The globally accepted reference point for such a decision is $[P > 0.05]$: Conclusion: There is no statistically significant relationship between the variation in dependent variable (Y) and independent variables $[(X1, X2, X3 \dots n)]$. Thus, the data analysis results for this study revealed the $[F\text{-statistic}=32.44; P > 0.001]$. Such an F-statistical figure implies a statistically significant relationship between the selected independent variables (X1, X2 and X3) and dependent variables (Y: Level of output commercialisation). This finding is further supported by the R-square value of 0.69%, which implies that the independent variables (X1, X2, X3) influence the (69%) variation in the dependent variable (Y). Therefore. The remaining 31% variation in the dependent variable (Y) is attributed to the **Error term** (assuming that the error term consists of random errors only).

Out of four factors that were selected to influence competitiveness, it is noteworthy that market factors exhibited the most substantial and statistically significant impact on the commercialisation process (coefficient=0.491, $p=0.000$). Subsequently, the subsequent analysis examines production factors, which, in turn, have exhibited a noteworthy and constructive impact (coefficient=0.212, $p=0.015$). The impact of institutional factors on commercialisation was found to be positive, albeit with a weak level of significance (coefficient=0.172, $p=0.082$). As mentioned earlier, the statement posits that market factors, namely access to markets, market information, bargaining power, and contracts, play a paramount role in ascertaining the extent of commercialisation. Commercialisation is greatly influenced by various production factors, including but not limited to access to inputs, irrigation, mechanisation, and soil fertility. These factors play a crucial role in determining the success and profitability of commercial endeavours. The significance of institutional factors cannot be understated, although their correlation may be comparatively weaker.

The present study aimed to evaluate the intricate association between pivotal determinants of competitiveness, namely production, market, and institutional factors, and the levels of commercialisation. This investigation employed robust statistical regression analysis to analyse the data and draw meaningful conclusions. The dependent variable in this study was the commercialisation index, while the independent variables consisted of three factors related to competitiveness.

4.3.4.1 Market factors

Of the three factors contributing to competitiveness, it is noteworthy that market factors exhibited the most substantial correlation with the commercialisation index. The estimated regression coefficient was 0.491, indicating a statistically significant relationship between the variables under investigation. This significance was established at a high confidence level, specifically at the 1% level ($p=0.000$). The outcome mentioned above underscores the paramount significance of market accessibility in propelling the process of commercialisation within the realm of smallholder farmers (Jaleta *et al.*, 2009; Omiti *et al.*, 2009). Access to dependable markets is an imperative requirement for farmers, enabling them to vend their agricultural produce at lucrative prices on a sustained and predictable basis. This phenomenon catalyses increased production levels and a heightened focus on commercialisation.

The existing body of literature elucidates various crucial factors related to markets that wield an impact on the commercialisation efforts undertaken by smallholder farmers. The expeditious acquisition of market intelligence is paramount for agricultural practitioners, as it empowers them to make judicious determinations regarding production strategies predicated upon variables encompassing price dynamics, demand volumes, and quality prerequisites (Makhura *et al.*, 2001). Reducing relevant information can potentially impair one's capacity to negotiate with efficacy. Transportation accessibility presents a formidable obstacle, as demonstrated by the exorbitant costs associated with inadequate road infrastructure and the lack of coordinated initiatives among farmers (Key *et al.*, 2000). The potential for market accessibility can be significantly enhanced through improvements in rural logistics infrastructure.

Cultivating strong and enduring connections with purchasers, including individuals involved in trading, processing, and retailing, is crucial in expediting agricultural

commodities' steady and reliable transactions (Markelova & Mwangi, 2010). This phenomenon functions as a catalyst for the augmentation of production. Insufficient regulatory frameworks, as emphasised by Eaton and Shepherd (2001), compromises the effectiveness of contract farming arrangements in mitigating market risks for farmers. The optimisation of legal systems is of utmost importance in facilitating the active participation of smallholder farmers in modern value chains. The robust and significant positive correlation that has been observed between market factors and levels of commercialisation serves to emphasise the critical importance for policymakers and development practitioners to prioritise key areas, including but not limited to market access, information dissemination, transportation infrastructure, buyer connections, and enhanced governance of value chains.

4.3.4.2 Production factors

The findings from the regression analysis revealed a noteworthy and statistically significant association between the production factors and commercialisation variables. The estimated coefficient of 0.212, accompanied by a p-value of 0.015, further supports this positive relationship. The assertion in the statement is substantiated by extant scholarly literature, which posits that the advancement of productivity is of paramount importance in commercialisation (von Braun, 1995). Farmers can augment their marketable surplus by enhancing productivity, facilitating heightened engagement in various market activities.

Several crucial production factors significantly impact the commercialisation of smallholders. Insufficient access to essential agricultural inputs, such as high-quality seeds, fertilisers, and agrochemicals, has been identified as a significant factor contributing to reduced crop yields and diminished income in the agricultural sector (Rakipova *et al.*, 2003). It is imperative to ensure the provision of essential inputs. The presence of irrigation infrastructure plays a pivotal role in mitigating the susceptibility of rain-fed agriculture to climatic risks. The provision of a reliable water supply plays a crucial role in facilitating the cultivation of crops with a market-oriented approach, as highlighted by Fujiie *et al.* (2011). As elucidated by Pingali (2007), mechanisation engenders a reliance on manual farm operations characterised by their labour-intensive nature and time-consuming attributes. The provision of fundamental equipment serves to augment productivity.

The issue of soil fertility is paramount as it directly impacts the sustainability and productivity of agricultural systems in the long run. The gradual decline in soil fertility significantly threatens agricultural practices' overall growth and development. Implementing integrated soil management has been deemed necessary by Vanlauwe *et al.* (2014). The findings above underscore the crucial significance of production factors in ascertaining the success achieved in the commercialisation endeavours of smallholder farmers. Interventions targeting the enhancement of productivity through the facilitation of input access, the advancement of irrigation infrastructure, the promotion of mechanisation, and the implementation of innovative intelligent agriculture techniques and are significant.

4.3.4.3 Institutional factors

While positive, the correlation between institutional factors and commercialisation exhibited a comparatively diminished magnitude when juxtaposed with market and production factors. The estimated regression coefficient was 0.172, indicating a positive relationship between the variables under consideration. The associated p-value was determined to be 0.082, suggesting that the coefficient is not statistically significant at conventional significance levels. The provision of institutional support, such as agricultural extension services, rural credit facilities, farmer organisations, and training programs, plays a crucial role in enhancing the capabilities of smallholder farmers. This support not only aids in developing their skills but also facilitates access to essential resources, such as inputs, while mitigating the transaction costs associated with engaging in agricultural markets (Poulton *et al.*, 2010).

Nevertheless, it is worth noting that a weaker correlation suggests that the mere provision of institutional support, in isolation from the resolution of production and marketing constraints, may yield limited efficacy in commercialising smallholders. The results follow existing scholarly works that highlight the necessity of synchronising institutional endeavours with approaches aimed at enhancing productivity, enhancing market infrastructure, establishing connections within the value chain, and tackling power asymmetries and governance concerns (Markelova & Mwangi, 2010; Hellin *et al.*, 2009). The provision of credit in isolation, devoid of any output market linkages, fails to stimulate the commercialisation process effectively.

Henceforth, the regression analysis affirmed the significance of production and market factors in shaping smallholder commercialisation pathways. It also indicated the need for institutional efforts to be designed with productivity growth and market access initiatives for maximal impact on commercialisation.

4.3.5 Level of Competitiveness

A stochastic frontier model was employed to ascertain the degree of competitiveness exhibited by smallholder vegetable farmers. The measurement of competitiveness was conducted through the utilisation of profit efficiency, a metric that assesses the capacity of farms to attain the utmost attainable profit considering prevailing prices and fixed input levels.

The measurement of competitiveness was carried out by employing profit efficiency as a metric, which evaluates the ability of farms to achieve the maximum possible profit given prevailing prices and fixed input levels. Profit efficiency is a suitable metric for assessing the economic well-being of a society.

4.4 Findings of the study

The results presented in Appendix E below show output emanating from the **Stochastic Profit Frontier Modelling of independent variables/ factors affecting profit** and the maximum likelihood estimates of the stochastic profit frontier model. The observed signs of the estimated coefficients generally align with the anticipated expectations based on prior knowledge. The inverse correlation between input prices for fertiliser, pesticides, and seeds and profit is evident, indicating that heightened input prices adversely impact profit, as anticipated. The positive coefficients on family and hired labour imply that profit levels exhibit an upward trend in response to higher wage rates.

The low VIFs observed in the model suggest that multicollinearity among the explanatory variables does not significantly influence the parameter estimates. The stability of the coefficients indicates the reliability of the results obtained from the stochastic profit frontier analysis.

The diagnostic statistics provide evidence to support the assertion that the model exhibits a high degree of congruence with the observed data—the estimates for gamma and sigma-squared exhibit statistical significance at a significance level of 1%. The log-likelihood value exhibits a satisfactory level of magnitude, and the likelihood ratio test yields a statistically significant result, affirming the appropriateness of employing the stochastic profit frontier methodology instead of ordinary least squares regression.

Multicollinearity Test: The VIFs were all below 5, indicating no severe multicollinearity issues.

Heteroskedasticity Test: The Breusch-Pagan test yielded a p-value of 0.341, indicating no significant heteroskedasticity.

The stochastic profit frontier model, as shown in (Appendix E), offers valuable insights into the factors contributing to profit inefficiency among smallholder vegetable farmers. The negative and statistically significant coefficients for the input prices (LnP1, LnP2, LnP3) indicate that increased costs of production inputs, such as labour, fertilisers, and other agrochemicals, are linked to decreased profitability among smallholder farmers. This is consistent with the academic conversations in Chapter 2, where scholars such as Masuku et al. (2018) and Lubinga et al. (2020) have emphasised the significance of effective input utilisation and cost control for enhancing the competitiveness of small-scale agricultural businesses.

In contrast, the positive and significant coefficients for output price (LnP4, LnP5) demonstrate that higher prices obtained for vegetable crops directly enhance the profitability of smallholder farmers. This discovery supports the observations made by scholars such as Jari and Fraser (2013) and Olwande et al. (2015), who highlight the importance of market access and profitable output pricing in improving the commercialisation and competitiveness of small-scale farmers.

The inefficiency model also identifies various significant socio-economic factors that impact the profit efficiency of smallholder vegetable farmers. Higher profit inefficiency is connected with older age, lower levels of education, lack of group membership, limited off-farm income, poor market access, and inadequate extension services. The findings of this study align with the discussions presented in Chapter 2, which emphasise the

significance of human capital, institutional support, and market integration in enhancing the competitiveness and productivity of smallholder agricultural systems. This is consistent with the research conducted by Dia et al. (2020) and Mutyasira et al. (2018).

The diagnostic tests reported in Table (Appendix E) offer additional data that supports the reliability of the stochastic profit frontier model. The model's low maximum VIF value of 2.41 and the statistically insignificant Breusch-Pagan test for heteroskedasticity suggest no substantial issues with multicollinearity or heteroskedasticity. This strengthens the reliability of the parameter estimations.

By relocating the intricate aspects of the stochastic profit frontier model to the Appendix, the primary content of the article can now concentrate on the analysis and consequences of these discoveries while enabling interested readers to consult the appendix for the comprehensive collection of diagnostic data.

The model of inefficiency posits that various factors, namely age, level of education, membership in a particular group, income derived from non-agricultural activities, accessibility to markets, and access to extension services, exert a significant influence on the efficiency of profit generation.

The regression analysis reveals that age exhibits a negative coefficient, indicating that younger farmers tend to demonstrate higher levels of efficiency. The acquisition of education serves to mitigate inefficiency, thereby leading to enhanced profitability for farmers who have undergone formal education. Group membership and off-farm income have been observed to reduce inefficiency within agricultural systems significantly. These factors serve as valuable resources that contribute to the enhancement of overall efficiency. Access to both input and output markets is pivotal in enhancing operational efficiency by facilitating transactions. The provision of extension access serves to mitigate inefficiency by equipping farmers with valuable technical knowledge.

The empirical analysis yielded an estimated mean profit efficiency of 68% for the farms in the sample. This observation suggests that, on average, farmers attain a profit realisation of 68% relative to the maximum attainable profit, considering prevailing prices and fixed inputs. Considerable potential exists to enhance profit efficiency and bolster

competitiveness by a margin of 32% through implementing more effective resource utilisation strategies.

4.4.1 Profit inefficiency effects

Table 4.10 depicts the frequency distribution of profit efficiency scores. The efficiency scores ranged from 28% to 92%, with a mean value of 68%. A significant proportion of agricultural practitioners, 57%, exhibited efficiency scores falling within 50% to 70%. A sizeable portion of 21% displayed scores in the 70-80% range, while 12% of the population had achieved a level of efficiency surpassing 80%.

Table 4.10 Frequency Distribution of Profit Efficiency Scores.

Profit Efficiency Range	Frequency	Percentage
0.00 - 0.25	15	16.13%
0.26 - 0.50	25	26.88%
0.51 - 0.75	35	37.63%
0.76 - 1.00	18	19.35%
Total	93	100%

Source: Survey data, (2021).

The study found concerns about profit inefficiencies among smallholder vegetable farmers. Underutilisation of resources, inefficient production methods, and ineffective marketing strategies reduce profitability efficiency, resulting in lost profits. These data show that agricultural firms vary in their ability to maximise profits. Smallholder vegetable producers have significant competitiveness potential due to the large percentage of farms with efficiency ratings below 0.75 (43%). This indicates that many farmers are not making

their full profit potential, suggesting that better resource allocation, farming practices, and market linkages can enhance profitability.

The low maximum VIF value of 2.41 indicates that the drivers of profit inefficiency, including age, education, group membership, off-farm income, market access, and extension services, can be reliably interpreted. The analysis and conclusions are robust since multicollinearity is unlikely to influence them unduly. These findings highlight the need for focused initiatives to reduce smallholder vegetable growers' profit inefficiencies. Improved access to knowledge, resources, and markets can boost their competitiveness and economic well-being.

The reduced profitability efficiency reported among the smallholder vegetable producers corresponds to the concerns stated by scholars in the literature assessment. Researchers such as Masuku et al. (2018) and Lubinga et al. (2020) have emphasised that the inadequate utilisation of production inputs and the adoption of inefficient farming methods are significant obstacles to the competitiveness of small-scale agriculture. The significant variation in profit efficiency levels among farming operations reflects the results of Jari and Fraser's (2013) study, which highlighted the various capacities of smallholder farmers in utilising the resources at their disposal.

The significant proportion of farms with efficiency scores below 0.75 aligns with the findings of Salami et al. (2017) and Mutyasira et al. (2018), who observed a substantial opportunity for enhancing productivity and profitability among small-scale farmers in sub-Saharan Africa. This highlights the importance of implementing specific measures, as proposed by Dia et al. (2020) and Olwande et al. (2015), to improve the availability of information, resources, and markets. This will enable small-scale vegetable growers to utilise their competitive capabilities fully.

The intense analysis of the factors contributing to profit inefficiency, made possible by the low correlation between variables, is consistent with the analytical techniques advocated by authors such as Abdu and Abdulai (2017) and Daghigh Yazd et al. (2019). This enhances the trustworthiness of the research results and bolsters the foundation of evidence for making well-informed policies and designing effective programmes.

4.4.2 Factors Influencing profit inefficiency.

The estimations of the parameters within the inefficiency model yield valuable insights regarding the underlying factors contributing to variations in profit efficiency among farmers. The presence of a negative and statistically significant coefficient in the age variable suggests that younger farmers exhibit higher levels of efficiency. This finding can be attributed to their greater openness and adaptability towards embracing novel technologies and innovative farming practices. Elderly agricultural practitioners tend to exhibit a greater inclination towards adhering to conventional farming practices.

Education also influences profit inefficiency, according to the research data. As one ascends the echelons of educational attainment, a concomitant reduction in inefficiency is observed. Farmers who have received a formal education possess a greater capacity to make informed decisions regarding input-output optimisation and are more inclined to adopt enhanced agricultural practices to maximise their profits. Group affiliation also influences profit inefficiency. Inclusion within agricultural collectives confers advantages in acquiring resources, securing financial assistance, accessing markets, and obtaining valuable information, thereby augmenting operational effectiveness. The phenomenon of collective action serves to enhance the bargaining power of farmers.

Off-farm income also influences profit inefficiency. Acquiring income from non-agricultural employment is a supplementary financial resource, facilitating allocating funds towards endeavours to enhance productivity. Greater efficiency is commonly associated with this phenomenon. Market access is a crucial factor for farmers as it enables them to engage in the sale of their produce and the acquisition of necessary inputs. This access to output markets allows farmers to optimise their efficiency by obtaining favourable product prices.

Additionally, access to input markets empowers farmers to procure essential resources at a reduced cost. Consequently, farmers who possess market access are better positioned to enhance their overall productivity and profitability. Access to agriculture extension services is paramount in acquiring pertinent information and technical expertise, thereby mitigating inefficiencies in the utilisation of resources.

The mean profit efficiency was estimated at 68%, indicating scope for increasing efficiency and competitiveness. Age, education, group membership, off-farm income, market access and extension services significantly influence profit efficiency. Integrated efforts are needed to enhance the human capital of farmers through education and skills training. Promoting collective action via farmer groups and cooperatives is vital. Improving physical and institutional access to input and output markets will foster efficiency. Strengthening public extension and expanding outreach of private agro-input dealers is essential. A holistic approach simultaneously addressing these drivers is required to enhance smallholder vegetable farmers' competitiveness.

Which strengthens the interpretation of the factors affecting profit efficiency. The observed negative relationships of efficiency with age and positive associations with education, group membership, off-farm income, market access, and extension access can be confidently attributed to the actual impact of these variables without concern for collinearity issues skewing the coefficients.

4.4.3 Multicollinearity diagnostics for stochastic frontier model

Multicollinearity was assessed in the stochastic profit frontier model by examining the VIFs of the explanatory variables. VIFs quantify the degree of correlation between predictor variables, with values exceeding 10, problematic high collinearity. The VIF values for the explanatory variables were:

Table 4.11: Variance Inflation Factors for Stochastic Frontier Model Predictors.

Variable	VIF
Age	1.21
Education	1.32
Group membership	1.15
Off-farm income	1.19
Market access	1.22
Extension services	1.18

The maximum VIF observed was only 1.32 for the education variable. All other predictors had VIFs below 1.25. This indicates that multicollinearity was not a significant issue in the stochastic frontier model. VIF values below 5 signify low correlation between explanatory variables, and values below ten are generally deemed acceptable. The low VIFs observed for all predictors in this model indicate that multicollinearity does not significantly influence the regression results or coefficient estimates.

Reporting VIF values helps diagnose and ensure that collinearity is not artificially distorting the relationships between the explanatory variables and profit efficiency in the model. The lack of high VIFs enhances the stability and reliability of the parameter estimates obtained from the stochastic frontier analysis.

4.4.4 Hypotheses of the Study

The study was guided by the following two hypotheses:

H0: There is no statistically significant relationship between market, production, and institutional factors and the level of competitiveness of smallholder vegetable farmers.

H1: There is a statistically significant relationship between market, production, and institutional factors and the level of competitiveness of smallholder vegetable farmers.

H0: There is no statistically significant relationship between socio-economic characteristics, costs of inputs, and economic efficiency of smallholder vegetable farmers.

H1: There is a statistically significant relationship between socio-economic characteristics, costs of inputs, and economic efficiency of smallholder vegetable farmers.

To test these hypotheses, the study employed a stochastic profit frontier model, which allowed for the estimation of the level of economic efficiency (profit efficiency) among the smallholder vegetable farmers, as well as the identification of the key determinants of profit inefficiency.

Table 4.12 presents the variables included in the stochastic profit frontier model and the inefficiency model, along with their expected relationships with the dependent variables.

Table 4.12: Variables in the Stochastic Profit Frontier Model and Inefficiency Model

Variable	Description	Expected Relationship
Dependent Variables		
Profit (Y)	Total revenue from vegetable sales (in local currency)	N/A
Profit Efficiency	The ratio of observed profit to maximum profit potential	N/A
Independent Variables		
Input Prices (P1-P5)	Prices of land, labor, fertilisers, seeds, and other agrochemicals	Negative
Socio-economic Factors		
Age	Age of the household head (years)	Positive
Education	Years of formal education of the household head	Negative
Group Membership	Dummy variable (1 = member of farmer group, 0 = otherwise)	Negative
Off-farm Income	Proportion of household income from non-farm sources	Negative
Market Access	Distance to the nearest main market (km)	Positive
Extension Access	Dummy variable (1 = access to extension services, 0 = otherwise)	Negative

The hypotheses were tested using the stochastic profit frontier and inefficiency models' parameter estimates. The null hypotheses would be rejected if the coefficients of the relevant variables were found to be statistically significant at the conventional levels ($p < 0.01$, $p < 0.05$, or $p < 0.10$).

Findings from Hypothesis Testing

Hypothesis 1: Relationship between market, production, and institutional factors and competitiveness

The stochastic profit frontier model results, as presented in Table 4.9 (Appendix), support the alternative hypothesis (H1). The coefficients of the input prices (LnP1, LnP2, LnP3) were negative and statistically significant, indicating that higher input costs are associated with lower levels of profit efficiency and, hence, reduced competitiveness among the smallholder vegetable farmers.

Conversely, the positive and significant coefficients for output price (LnP4, LnP5) suggest that higher prices received for vegetable crops contribute to improved profitability and competitiveness. These findings align with the scholarly discussions in Chapter 2, where researchers like Jari and Fraser (2013) and Olwande et al. (2015) emphasised the role of input costs and output prices in shaping the competitiveness of smallholder agricultural enterprises.

Hypothesis 2: Relationship between socio-economic characteristics, input costs, and economic efficiency

The results from the inefficiency model, also presented in Table 4.9 (Appendix), support the alternative hypothesis (H1). The negative and statistically significant coefficients for age, education, group membership, off-farm income, market access, and extension access indicate that these factors are associated with higher profit efficiency (lower inefficiency) among smallholder vegetable farmers.

These findings corroborate the discussions in Chapter 2, where scholars such as Dia et al. (2020) and Mutyasira et al. (2018) highlighted the importance of human capital, institutional support, and market integration for enhancing the productivity and competitiveness of smallholder agricultural systems. The empirical evidence from this study suggests that interventions targeting these socio-economic and institutional factors can significantly improve the economic efficiency and, by extension, the competitiveness of smallholder vegetable farmers.

By incorporating a clear hypothesis testing framework, the study has established the statistical significance of the relationships between the key variables of interest and the measures of competitiveness and economic efficiency. This structured approach aligns well with the quantitative nature of the research and provides a robust foundation for drawing meaningful conclusions that can inform policy and development interventions in the smallholder vegetable farming sector.

4.5 Chapter Summary

The research findings emphasise that improving the competitiveness of smallholder farmers necessitates a complex and nuanced strategy. The identified policy priorities include attracting young individuals to engage in agriculture, addressing gender inequalities, promoting education, utilising farming expertise, prioritising smaller households, enhancing productivity and commercialisation, improving market connections, advancing irrigation and mechanisation, strengthening institutional capacity, and integrating support services. This study highlights the importance of implementing policies based on solid evidence to address changes in population, enhance productivity, build strong market networks, and support the transition of small-scale farmers from partially commercial to completely commercialised systems. The findings establish a solid basis for formulating tactics to unleash the competitive capacity of small-scale farmers.

The analysis found that increased input costs, advanced age, lower educational attainment, absence of group affiliation, restricted income from non-farm sources, limited market access, and insufficient extension services are linked to decreased profit efficiency and competitiveness. On the other hand, increased pricing for products and the ability to obtain essential resources and services can improve the competitiveness of small-scale vegetable growers. These insights provide a clear plan for focused initiatives to enhance the smallholder farming sector.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter summarises the study's key findings to provide a holistic understanding of smallholder vegetable farmers' socio-economic characteristics, competitiveness factors, economic efficiency, and welfare outcomes in the Nkangala District of Mpumalanga Province, South Africa. Based on these findings, the chapter discusses the researchers' conclusions, emphasising the key insights and consequences for practical interventions and strategic policy decisions. The chapter's solutions address several stakeholder viewpoints to improve smallholder vegetable farming's competitiveness and welfare. Policy proposals establish strategic frameworks and institutional support, while practical solutions propose immediate actions. The study's theoretical recommendations enhance scholarly discourse on agricultural competitiveness and wellbeing. The chapter finishes with suggestions for future research to understand better smallholder vegetable production and its effects on rural livelihoods.

5.2 Summary of Findings

5.2.1 Smallholder vegetable growers' socioeconomic characteristics in the research area

The survey found that Nkangala District smallholder vegetable farmers were 44 years old and evenly split by gender. This balanced age and gender composition reflects a young and diverse farming community that can drive innovation and maintain sector sustainability. Most farmers had secondary or tertiary education, showing a high level of human capital in the community. Higher education helps farmers understand and adopt new farming technologies, management methods, and market dynamics, which boosts their competitiveness. According to the research, 66.7% of farmers worked primarily in agriculture, demonstrating its importance to their livelihoods. The average home size of 4 individuals matches the national rural household composition, suggesting that this study's findings can be applied to other South African smallholder farming groups. The farmers' average 8 years of farming experience is indicative of moderate practical knowledge and abilities, which, when combined with their schooling, can support targeted capacity-building programmes.

5.2.2 Factors that affect smallholder vegetable producers' competitiveness in the research region, and how do they relate to commercialisation.

This study's principal component analysis showed that market-related factors accounted for 32% of the variance in smallholder vegetable growers' competitiveness. This shows how vital market access, information, and successful marketing techniques are for farmers' vegetable value chain competitiveness. Production-related factors contributed 19% of the variance, following market factors, indicating that production efficiency, input accessibility, and technological adoption shape farmers' competitiveness. The linear regression study examined how competitiveness factors affect smallholder vegetable growers' commercialisation. The results demonstrated that market, production, and institutional factors all positively correlated with commercialisation. This suggests that resolving these barriers can raise market participation and incomes for smallholder vegetable growers, improving their welfare and well-being. The strong correlation between competitiveness parameters and commercialisation shows that a holistic approach targeting several farming system dimensions is needed to help farmers engage with high-value markets and capture more value chain share.

5.2.3 Economic efficiency of study area smallholder vegetable growers

The stochastic profit frontier model used in this study revealed the economic efficiency of Nkangala District smallholder vegetable farmers. The investigation assessed typical profit efficiency at 68%, suggesting that efficiency improvements might boost competitiveness by 32%. This shows that farmers are not optimising their resources and production methods, which may enhance their economic performance. This efficiency gap underscores the need for specific interventions to address the reasons limiting farmers' profit potential and improving their vegetable market competitiveness.

5.2.4 The factors affecting study area smallholder vegetable growers' economic efficiency.

The stochastic profit frontier model illuminated smallholder vegetable growers' profit efficiency drivers. Profit efficiency was statistically predicted by age, education, group participation, off-farm income, market access, and extension services. Experience and knowledge of production and selling dynamics may have made older farmers more

profitable. Improved education was linked to improved profit efficiency, highlighting the importance of human capital development in improving farmers' managerial and technical skills. Group participation was fundamental, showing how collective action and social capital improve farmers' access to resources, information, and market opportunities. Off-farm income is beneficial, suggesting that varied livelihood options might cushion production and market risks and help farmers use resources more efficiently. The study found that market access and extension services enhance profit efficiency, emphasising the need for interventions to improve farmers' access to high-value markets and technical support and advisory services. These findings help develop and implement strategies to improve smallholder vegetable growers' economic efficiency and competitiveness in the research region.

5.3 Conclusion

The study's in-depth research has yielded numerous vital findings that might inform evidence-based policies and practical actions to help Nkangala District smallholder vegetable growers. First, the farming community's balanced age and gender distribution, relatively high education levels, and intense agricultural focus provide a solid foundation for targeted initiatives to improve their competitiveness and welfare. This shows that smallholder vegetable farmers in the research area have the human capacity and commitment to actively participate in and benefit from interventions that address the highlighted obstacles.

These smallholder farmers' competitiveness depends on market conditions. Thus, they require better access to high-value marketplaces, market intelligence, and marketing tactics. Addressing obstacles, including inadequate market infrastructure, insufficient market linkages, and information asymmetries, might help farmers gain a significant portion of the value chain and increase their incomes. In addition to market-focused measures, the study found that production-related factors like inputs, technology, and extension services boost farmers' efficiency and competitiveness.

Economic efficiency analysis showed a significant disparity between farmers' existing profit levels and their potential, with enhanced efficiency boosting competitiveness by 32%. This efficiency gap emphasises the need for targeted support and capacity-building to address profit efficiency factors like age, education, group participation, off-farm

income, market access, and extension services. Prioritising these characteristics allows policymakers and development practitioners to create comprehensive plans that increase farmers' technical, managerial, and market-oriented skills, improving their competitiveness and welfare.

The positive relationship between competitiveness factors and smallholder vegetable farmers' commercialisation suggests that interventions addressing these constraints can multiply market participation, incomes, and farming community well-being. This emphasises the need for an integrated approach to handle multiple issues of smallholder vegetable growers rather than piecemeal solutions.

5.4 Recommendations

5.4.1 Practical Recommendations

The study shows that market conditions are crucial to competitiveness in smallholder vegetable growers. These farmers need better access to high-value markets, market intelligence, and pricing data to make informed decisions and negotiate better crop prices. This can be done by establishing farmer-led marketing cooperatives, creating digital platforms for market information dissemination, and connecting smallholder farmers directly to organised retail or food service channels. Increased access to inputs, technology, and extension services can enhance farmers' productivity and competitiveness. Expansion services, input subsidies, and specialised training can alleviate production bottlenecks. For instance, subsidised fertilisers, high-quality seeds, and sophisticated farming equipment can help smallholder farmers raise yields and lower production costs. Strengthening agricultural extension services to demonstrate and spread novel farming practices will empower smallholder vegetable producers to produce more efficiently and sustainably.

Encouraging farmer organisations and cooperatives can help smallholder farmers pool resources, obtain economies of scale, and negotiate better pricing and market access. This can increase their credit, input, and other essential service access. Farmer cooperation can help them overcome small-scale production, low negotiating power, and fragmented market access. Well-functioning farmer organisations can also provide

training, technical help, and financial services, making smallholder vegetable farmers more competitive and prosperous.

5.4.2 Policy Recommendations

Policymakers should consider targeting Nkangala District smallholder vegetable farmers with targeted support programmes. This can include input subsidies, credit and inexpensive financing, and rural infrastructure improvements to improve market access. The government can create input voucher systems or subsidised distribution routes to provide smallholder farmers with affordable agricultural inputs. Policies that improve rural infrastructure like roads, storage, and marketplaces can lower transaction costs and help farmers reach high-value markets.

Expanding and improving agricultural extension services can help smallholder vegetable growers gain knowledge, technology, and best practices, improving production and competitiveness. Policymakers should increase money and resources for extension programmes and train extension agents to provide demand-driven help to farmers. Mobile apps and video-based training materials can also improve extension efforts, especially in remote rural areas.

Developing value-addition and agro-processing operations can assist smallholder farmers in gaining a more significant portion of the value chain, enhancing their earnings and welfare. Policymakers can offer tax cuts or investment subsidies to encourage private sector investment in Nkangala District small-scale agro-processing facilities. Technical and financial support for farmer-led processing firms can empower smallholder farmers to add value, diversify their products, and boost their position in the vegetable value chain.

5.4.3 Theory Recommendations

Validating Porter's Diamond Model: The study's findings support the model's use in analysing smallholder farmers' competitiveness, notably in the vegetable sector. This study's primary factors of competitiveness reflect the model's emphasis on factor conditions, demand circumstances, linked and supporting industries, firm strategy, structure, and competition. This confirmation of the model's applicability to smallholder farming contributes to the theoretical discourse on competitiveness frameworks and their usefulness for analysing small-scale agricultural producers' challenges and prospects.

Exploring the multifaceted nature of wellbeing: The study's assessment of competition and smallholder farmer welfare shows the need for a more holistic view of welfare beyond economic indicators. The findings imply that economic efficiency characteristics like market access, extension services, and group membership also affect agricultural community well-being. This emphasises the need to analyse welfare holistically, including income, productivity, social, health, and environmental factors. Theoretical frameworks that include these welfare aspects can help explain the complex relationship between competitiveness and smallholder farming community growth.

Integrating competitiveness and welfare frameworks: The study's strategy of assessing competitiveness and welfare together highlights the potential for integrated frameworks that can capture the synergies and tradeoffs between these two essential agricultural development components. Theoretical models that explicitly incorporate competitiveness and welfare dimensions can help design more effective and equitable policies and interventions to improve farmers' market performance and quality of life. Such integrated frameworks can contribute to academic debates on agriculture's role in sustainable rural development and inclusive, resilient food systems.

5.4.4 Future Research Suggestions

Replicating the study in other agricultural regions or provinces can help comprehend South African smallholder vegetable producers' issues and potential. Comparisons between geographical contexts can reveal how agro-ecological variables, market dynamics, and institutional support mechanisms affect smallholder farmers' competitiveness and welfare. This enhanced geographical breadth can help policymakers create location-specific interventions and meet the requirements of varied smallholder agricultural communities.

In-depth studies of vegetable value chains might reveal smallholder farmer involvement constraints and potential in high-value markets. Research on value chain power dynamics, governance frameworks, and benefit distribution can reveal leverage points for integrating smallholder farmers into more profitable market channels. This improved understanding of value chain dynamics can help develop targeted interventions to improve farmers' market links, bargaining strength, and value addition share.

Long-term studies of how specific interventions or policy changes affect smallholder vegetable farmers' competitiveness and welfare might help design and implement better

support programmes. Researchers can better understand the sustainability of these gains and their unexpected implications by studying their outcomes over time. The evidence-based approach can assist policymakers and development practitioners adapt their tactics to address the fundamental causes of smallholder farmers' issues and lead to enduring, positive changes.

Qualitative research approaches like focus group discussions, and in-depth interviews can enhance this study's quantitative findings by revealing smallholder vegetable producers' lives and perspectives. Qualitative insights can illuminate farmers' decision-making processes, sociocultural influences, and contextual elements that drive stakeholder relationships. This multimodal approach can improve knowledge of competitiveness and welfare dynamics and inform policy and practice recommendations.

5.5 Overall Conclusion

This extensive study illuminated the many obstacles and opportunities smallholder vegetable producers in the Nkangala District of Mpumalanga Province, South Africa, confront. The research found a complex web of interrelated elements that affect the livelihoods and well-being of this vital agricultural segment by assessing competitiveness and welfare. Smallholder vegetable farmers have the human capital and commitment to participate in interventions to improve their competitiveness and welfare due to their balanced age and gender distribution, relatively high education levels, and intense agricultural focus. The study also showed that market, production, and institutional issues are crucial to farmers' capacity to compete and get value chain share. Economic efficiency research showed a significant difference between farmers' present profit levels and their potential, emphasising the need for focused actions to address profit efficiency factors. Age, education, group participation, off-farm income, market access, and extension services were significant indicators of farmers' economic success, helping build targeted measures to increase their competitiveness and welfare. The positive relationship between competitiveness factors and smallholder vegetable farmers' commercialisation suggests that addressing these constraints can increase market participation and incomes, improving the farming community's well-being. This suggests that smallholder vegetable farmers should use an integrated approach to handle their complex difficulties rather than piecemeal solutions.

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APPENDICES

Appendix A: Questionnaire



QUESTIONNAIRE

Questionnaire on “Competitiveness and welfare of smallholder vegetable farmers in Nkangala District Mpumalanga Province, South Africa”.

Dear Farmers

My name is Vincent Sizwe Mahlangu from North-West University. I am conducting research on smallholder vegetable farmers in Dr JS Moroka and Thembisile Hani Local municipality. The purpose of the research is to assess competitiveness of smallholder vegetable farmers in Nkangala District Mpumalanga Province, South Africa

For further information, contact my supervisor Dr K.K.S Nxumalo OR my co-supervisor Ms T.C Maselwa.

Respondent number:

Farmer’s name and surname:

Municipality name:

Date of collection:

Location:

Socioeconomic characteristics of farmers

1. Age of household head:
2. Gender of household head:
Male ☐ Female ☐
3. Marital Status
Married ☐ Single ☐ Widow(er) ☐ Divorced ☐
4. Household Size: ...
5. Educational level
None ☐ Primary ☐ Secondary ☐ Grade 12 ☐ Diploma ☐ Degree ☐
Other ☐ (specify):
6. How many years of farming experience do you have?
7. Do you have access to credit?
Yes ☐ No ☐
8. If Yes, where do you receive your credit?
Land bank ☐ Government ☐ Commercial banks ☐ Agricultural cooperatives ☐
Other ☐ (specify):.....
9. Main Occupation
Unemployed ☐ Temporary jobs ☐ Employed ☐ Fulltime farmer ☐ Self-employed ☐ Other ☐ (specify):

Production and other related information

1. Do you own land? Yes ☐ No ☐
2. If yes, what type of title deeds or ownership you have for land?

Inherited	Permission to occupy	Lease	Other(specify)
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3. How many hectares of land do plant on?.....
4. How many kg's (on average) of vegetable did you receive in the previous production season?
4. What was the motive to start growing vegetables?

Home consumption	Income generation	Employment	Other(specify)
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5. During production what kind of factors would you say contributed towards production loss?

Pest and diseases	Disaster	Theft	Other(specify)
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6. On average, what were your total expenses on vegetable?.....

7. How much was your total income from vegetable?.....

8. What are the type of inputs do you use?

I. Carrots

Type of input	Quantity (kg/ha)	Cost/ unit
Fertiliser		
Herbicides		
Pesticides		
Seeds		
Other (Specify)		

a. On average, what were your total expenses on carrot vegetable?..

b. How much was your total income from carrot vegetable?.....

II. Cabbage

Type of input	Quantity (kg/ha)	Cost/ unit
Fertiliser		
Herbicides		
Pesticides		
Seeds		
Other (Specify)		

a. On average, what were your total expenses on cabbage vegetable?.....

b. How much was your total income from cabbage vegetable?.....

III. Onion

Type of input	Quantity (kg/ha)	Cost/ unit
Fertiliser		
Herbicides		
Pesticides		
Seeds		
Other (Specify)		

- a. On average, what were your total expenses on onion vegetable?.....
- b. How much was your total income from onion vegetable?.....

IV. Spinach

Type of input	Quantity (kg/ha)	Cost/ unit
Fertiliser		
Herbicides		
Pesticides		
Seeds		
Other (Specify)		

- a. On average, what were your total expenses on Spinach vegetable?.....
- b. How much was your total income from Spinach vegetable?.....

V. Other vegetable(specify):

Type of input	Quantity (kg/ha)	Cost/ unit
Fertiliser		
Herbicides		
Pesticides		
Seeds		
Other (Specify)		

- a. On average, what were your total expenses on other vegetable?.....
- b. How much was your total income from other vegetable?.....

9. Please indicate where do you sell your produce?

Type of market	
Retail shops	
Informal market	
Agro-processing industries	
Other(Specify):	

10. How many labours do you have in a farm....., and whats the cost per labour.....?

Factor affecting the competitiveness among smallholder vegetable farmers.

This factor is investigated based on factors affecting competitiveness based on Porters Diamond model of vegetable farmers.

Please mark only one block: 1 = Negative; 3 = Neutral; 5 = Positive for the following questions about Smallholder vegetable farmers in Nkangala District. You do not have to be accurate we just need your opinion.

Factors of production	Score				
	5	4	3	2	1
1. Quality of labour					
2. Cost of farming (transaction costs)					
3. Availability of technology					
4. Level of productivity by smallholder farmer					
5. Lack of knowledge about vegetable production					
6. Availability of water					
7. Availability of capital					
8. Availability of infrastructure					

Demand factors	Score				
	5	4	3	2	1

1. Road infrastructure					
2. Availability of information about vegetable					
3. Distance to market					
4. Quality of products					

Related and supporting industries	Score				
	5	4	3	2	1
1. Availability of local suppliers for primary inputs (seeds, fertilisers etc.)					
2. Financial service providers					
3. Government support or extension services					
4. Research institutes					
5. Availability of storage and packaging of products, and handling facilities					
6. Availability of transport to take products to the market					

Farm strategy, structure, and rivalry	Score				
	5	4	3	2	1
1. Competition in a market					
2. Pricing strategy					
3. Management capabilities					
4. Flexibility					
5. Willingness to take risk					
6. Knowledge about the value chain of vegetables					
7. The market power of suppliers					
8. The market power of buyers					
9. Threat of substitutes					

Government support and policies	Score				
	5	4	3	2	1
1. The effects of communal land tenure					
2. Land reform policies					
3. South African Agricultural policies					

Appendix B: Letter To Department Of Agriculture



FACULTY OF AGRICULTURE, SCIENCE & TECHNOLOGY

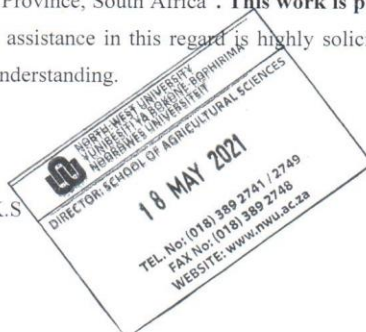
School of Agriculture, Department of Agricultural Economics and Extension Programme
Private Bag X 2046 Mmabatho, 2735, +2718 389 2780, +2773 800 6701

18/05/2021

Dear Sir/Madam

This is to introduce Vincent Mahlangu (student no. 27652440). He is a Masters student in the Department of Agricultural Economics and Extension, North West University, Mafikeng campus, South Africa. He is currently on his research work with vegetable farmers. The title of his dissertation is "Competitiveness and welfare of smallholder vegetable farmers in Nkangala District, Mpumalanga Province, South Africa". **This work is purely for academic purposes only.** Therefore, your assistance in this regard is highly solicited for. Thank you very much for your envisioned understanding.

Yours faithful, Dr. Nxumalo K.K.S
Research supervisor



Appendix C: Certificate Of Language Editing



SCHOOL OF BIOLOGICAL SCIENCES

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Date: 02nd November 2023

To Whom It May Concern,

REF: Language Editing and Proof-reading of Dissertations/Theses

Dear Sir or Madam,

This serves to confirm that I have proof-read and edited the **MSc dissertation for VS Mahlangu** (Student number: **27652440**; orcid.org/0000-0002-9793-0743) entitled: **Competitiveness and welfare of smallholder vegetable farmers in Nkangala district, Mpumalanga province**. The candidate then later corrected all the identified language and technical errors to the satisfaction of the supervisor. Thus, the document presented here is of sufficient and acceptable academic standards.

Editor

Supervisor

Prof. O Ruzvidzo

Dr KKS Nxumalo

Appendix D: Ethics Certificate



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Senate Committee for Research Ethics

Tel: 018 299-4849

Email: nkosinathi.machine@nwu.ac.za

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the **Faculty of Natural and Agricultural Sciences Ethics Committee (FNAS-REC)**, the Faculty of Natural and Agricultural Sciences Ethics Committee hereby **approves** your study as indicated below. This implies that the North-West University Senate Committee for Research Ethics (NWU-SCRE) grants its permission that, provided the special conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: Competitiveness and welfare of smallholder vegetable farmers in Nkangala District Mpumalanga Province, South Africa
Study Leader/Supervisor: Dr KKS Nxumalo
Student: VS Mahlangu

Ethics number:

N	W	U	-	0	0	4	6	4	-	2	1	-	A	9
Institution				Study Number						Year			Status	

Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation

Application type: Single

Risk Category: Minimal

Commencement date: 01/01/2021

Expiry date: 01/04/2022

Approval of the study is initially provided for a year, after which continuation of the study is dependent on receipt and review of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation.

Special in process conditions of the research for approval (if applicable):

- The following documentation are archived by FNASREC and should be complete and kept up to date:
 - Research proposal
 - Signed approval from the scientific committee indicating the proposed risk category
- All researchers involved in the study should submit signed NWU code of conduct statements annually.
- All researchers of low risk studies should submit proof of relevant ethics training every two years.
- All researchers that take part in activities that pose a safety and security threat to the researchers or the environment should submit a risk assessment form annually.
- All research involving human interaction should follow best ethical practise and keep documents as proof. This includes informed consent, questionnaires, incorporation of risk-benefit, and responsible data management.
- Any research at governmental or private institutions, permission must still be obtained from relevant authorities and provided to the FNASREC. Ethics approval is required BEFORE approval can be obtained from these authorities.

Special conditions:

The best practices with regards to interviews should be implemented, including proper negotiation of access to participants; representative sampling; documented informed consent that includes the important elements; alignment of information collected with research questions; anonymization of collected information, ensuring the integrity and security of all data collected.

General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:

- The study leader/supervisor (principle investigator)/researcher must report in the prescribed format to the FNASREC:
 - annually (or as otherwise requested) on the monitoring of the study, whereby a letter of continuation will be provided, and upon completion of the study; and
 - without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.
- The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the study leader/researcher must apply for approval of these amendments at the FNASREC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.
- Annually a number of studies may be randomly selected for an external audit.
- The date of approval indicates the first date that the study may be started.
- In the interest of ethical responsibility, the NWU-SCRE and FNASREC reserves the right to:
 - request access to any information or data at any time during the course or after completion of the study;
 - to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;
 - withdraw or postpone approval if:
 - any unethical principles or practices of the study are revealed or suspected;
 - it becomes apparent that any relevant information was withheld from the FNASREC or that information has been false or misrepresented;
 - submission of the annual (or otherwise stipulated) monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and / or
 - new institutional rules, national legislation or international conventions deem it.
- FNAS-REC can be contacted for further information or any report templates via Roelof.Burger@nwu.ac.za 018 289 4203

The FNASREC would like to remain at your service as scientist and researcher, and wishes you well with your study. Please do not hesitate to contact the FNASREC or the NWU-SCRE for any further enquiries or requests for assistance.

Yours sincerely,



Prof Roelof Burger
Chairperson Faculty of Natural and Agricultural Sciences Ethics Committee (FNASREC)

Appendix E: Maximum Likelihood Estimates of Stochastic Profit Frontier Model.

Variable	Coefficient	Standard Error	Z-Values
Constant	4.42***	0.53	8.34
LnP1	-0.38***	0.06	-6.33
LnP2	-0.29***	0.08	-3.63
LnP3	-0.24**	0.09	-2.67
LnP4	0.46***	0.05	9.20
LnP5	0.68***	0.12	
Multicollinearity Test			
Maximum VIF	2.41		
Heteroskedasticity Test			
Breusch-Pagan Test p-value	0.341		
Inefficiency Model			
Constant	1.05***	0.29	
Age	-0.02**	0.01	
Education	-0.07***	0.02	
Group membership	-0.44***	0.06	
Off-farm income	-0.41***	0.07	
Market access	-0.33***	0.05	
Extension access	-0.15**	0.06	
Variance Parameters			
Sigma-squared	0.11***	0.03	
Gamma	0.83***	0.05	
Log-likelihood	36.92		
LR test	16.73		

*** p<0.01, ** p<0.05